THE JOURNAL OF GAS LIGHTING
WATER SUPPLY & SANITARY IMPROVEMENT

VOL. LXVIII. No. 1737.] LONDON, AUGUST 25, 1896. [48TH YEAR. PRICE 6d.

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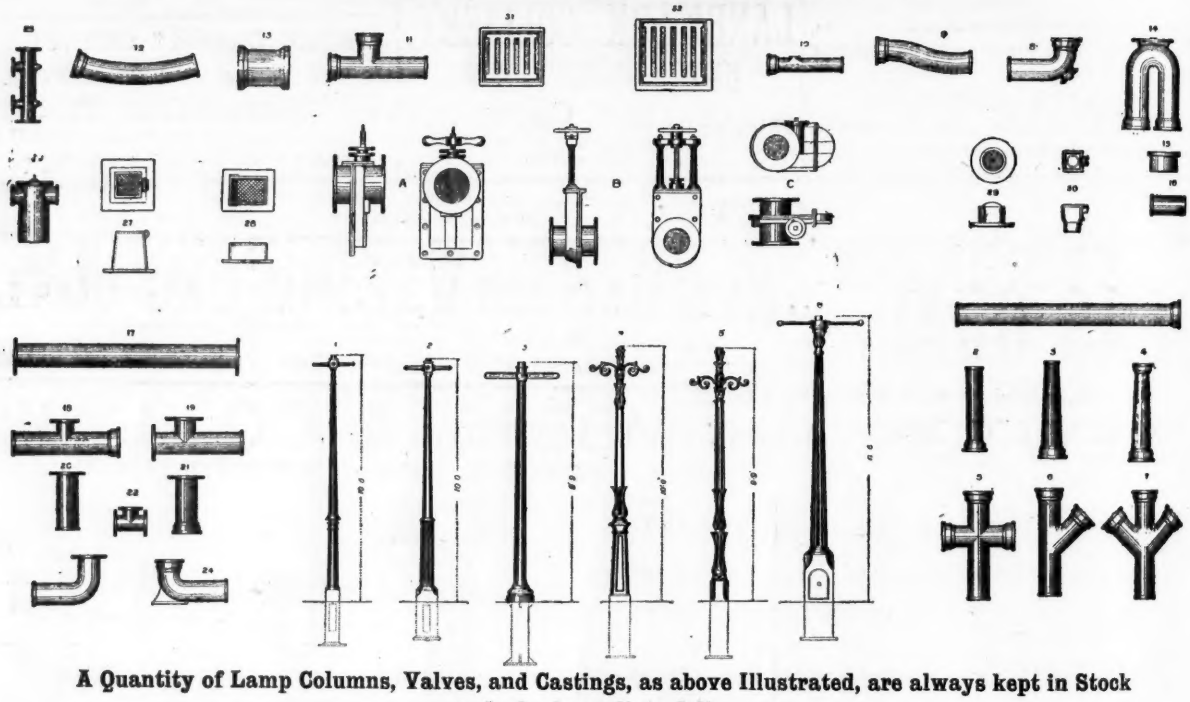

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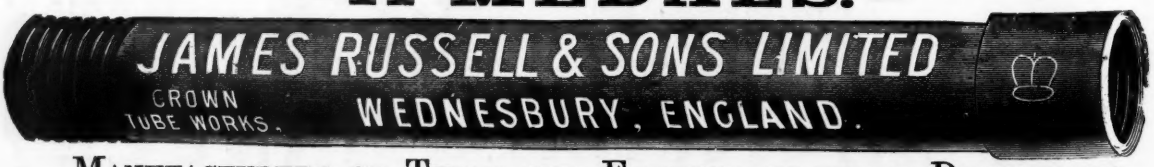

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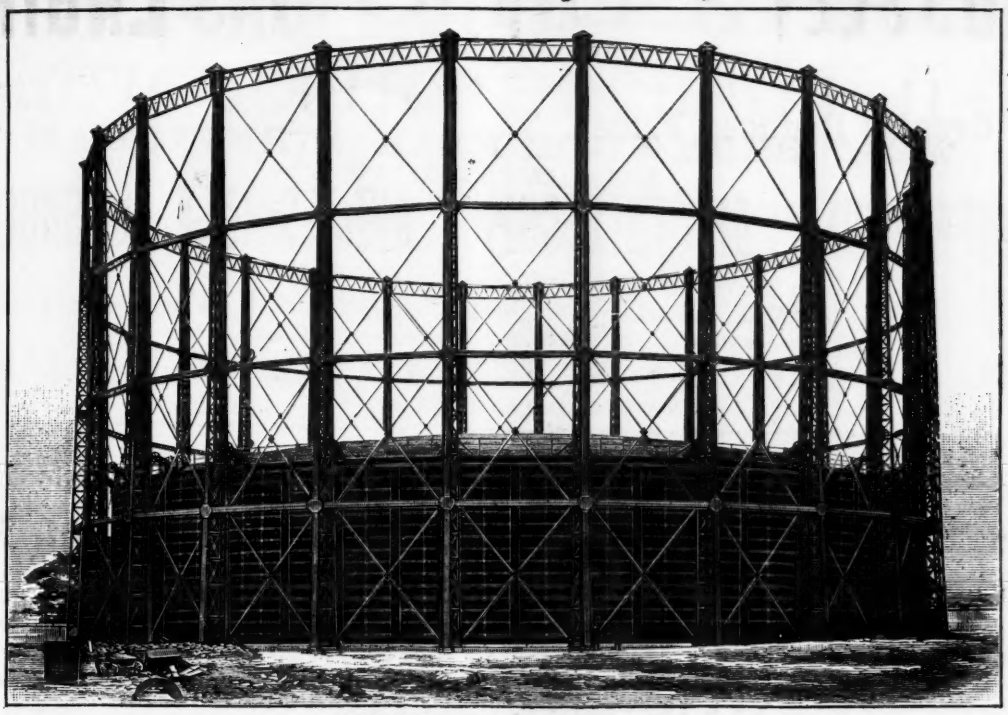

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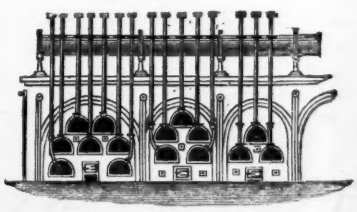

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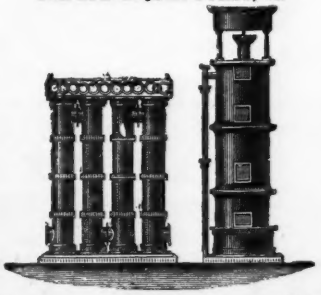

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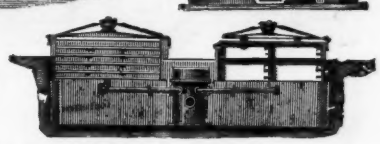

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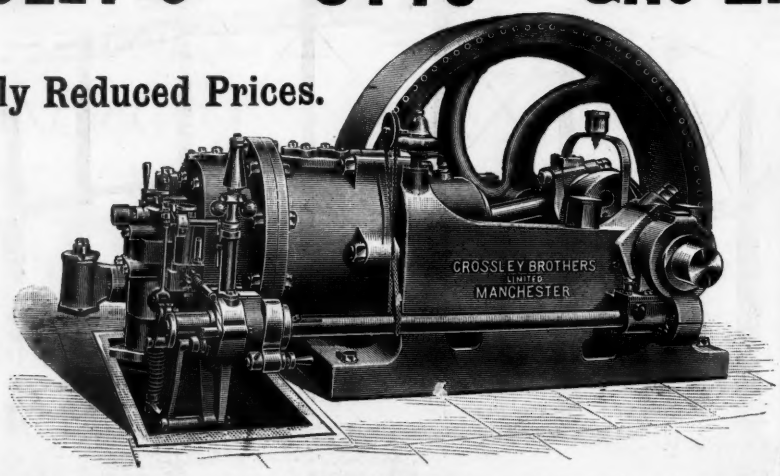

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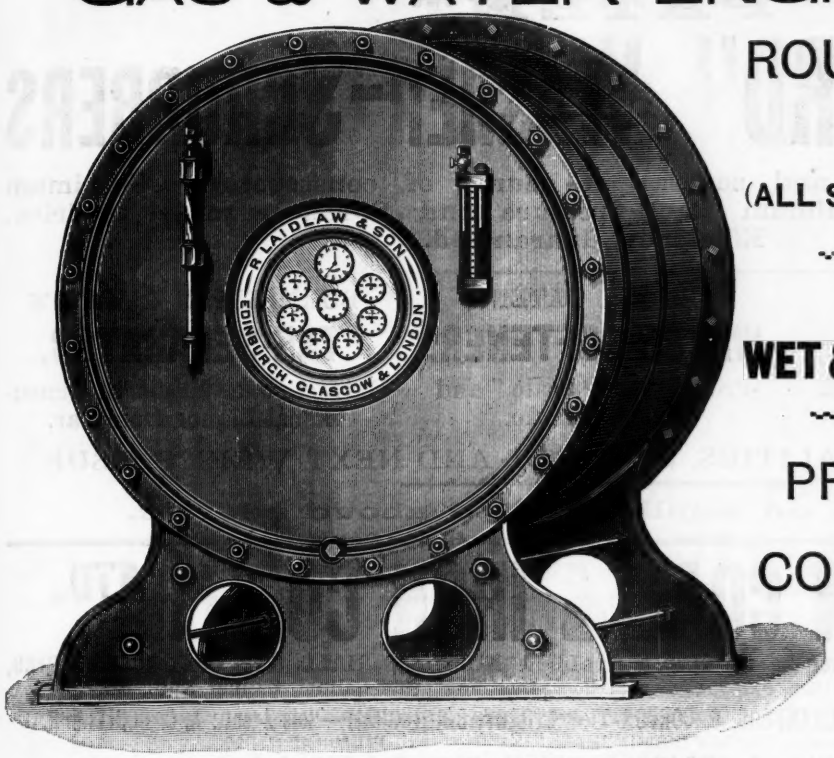

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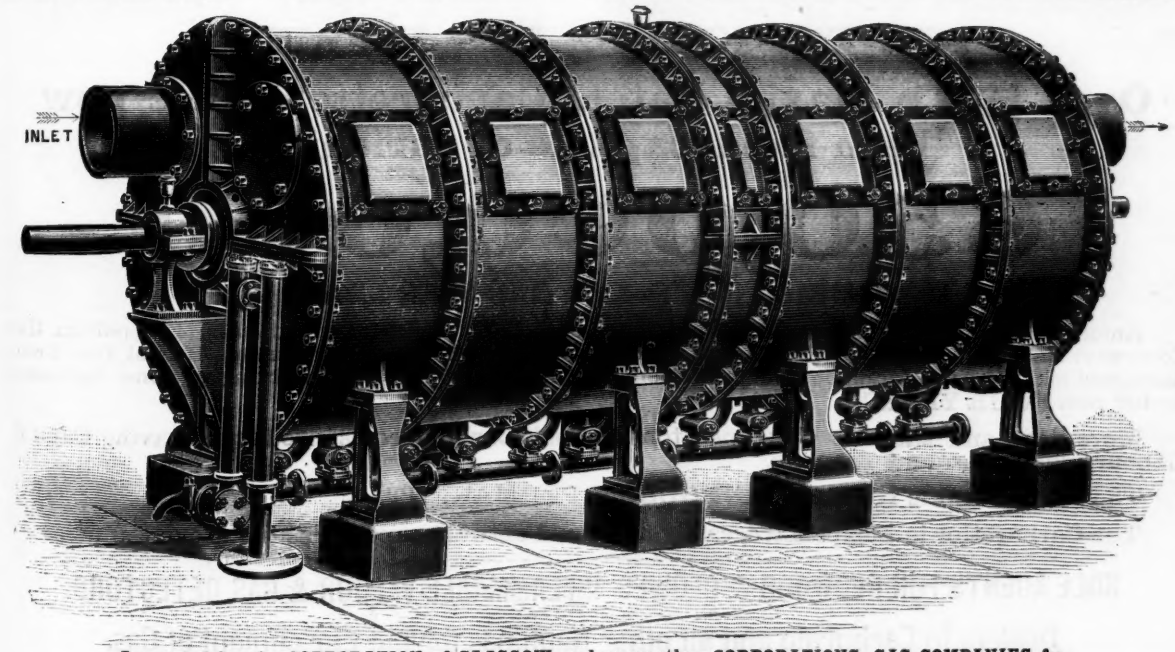

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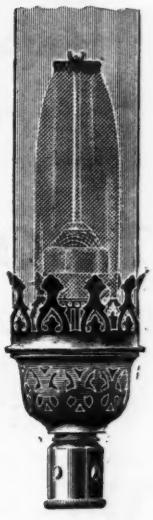

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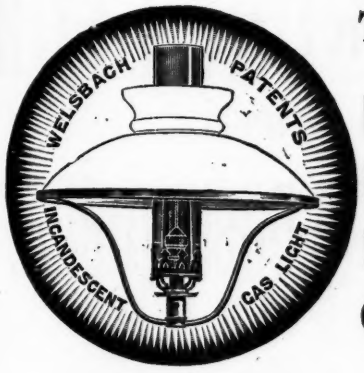

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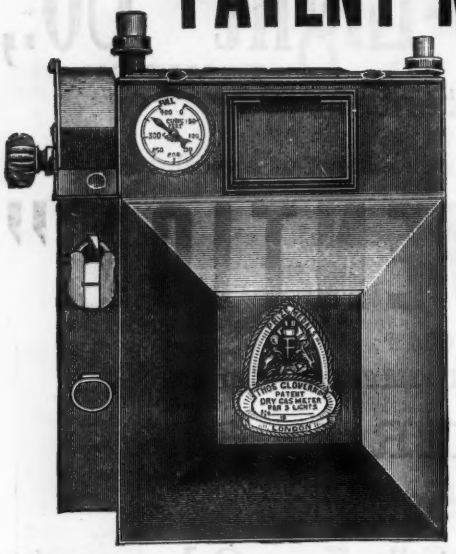

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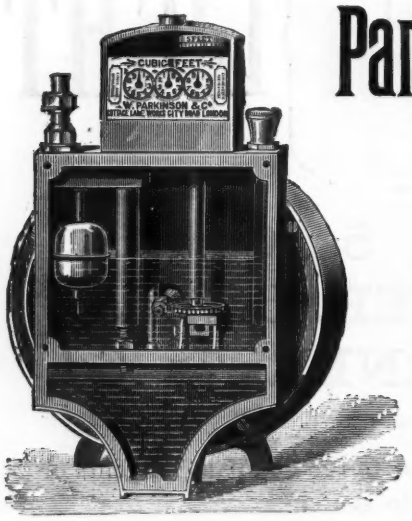

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EDITORIAL NOTES.

The Meeting of the Liverpool Gas Company.

THE Liverpool Gas Company had a very satisfactory meeting last Tuesday, when the Chairman, Mr. Edward Lawrence, was able to give such an account of the year's operations as must have gone far to reassure the proprietors and the Liverpool public both as to the soundness of the undertaking and the efficiency of its administration and management. To have earned full statutory dividends, notwithstanding the depreciation of residuals, and to be able to make a reduction in the price of gas, are no small triumphs for any Gas Company to achieve under existing circumstances; and these evidences of the ability of the present management of the Liverpool undertaking constitute a striking endorsement of the findings of the recent Corporation inquiry, which concluded emphatically against the idea that it would be expedient to municipalize the gas supply. Mr. Lawrence was fully justified in claiming the result of this inquiry as a more complete vindication of the Company from all the charges that have been made against them during the past few years than anything the Directors could have attempted with the same object. The Company's enemies now stand thoroughly discomfited in respect of the allegations of maladministration which have been published by them so freely and with such reckless disregard of plain facts; and there is ground for the Chairman's hope that no more will now be heard of these charges. The reduction in the price of gas is the best proof that could be offered as to the competence of existing arrangements to ensure that the people of Liverpool shall have the benefit of whatever improvement in the Company's commercial circumstances the course of trade may from time to time bring about. More than this no substituted arrangements that can be conceived as possible could be depended upon to afford. Nothing was said at the meeting concerning the course that may be taken in the future respecting the matters of administration touched upon in the report of the Lighting Committee of the Corporation; but these are not at present in a state to be laid before the shareholders or the public. It is to be supposed that something will shortly be done towards the further clearing up of such points as the admission of Nominee Directors on the Board of the Company, and the alteration of the statutory illuminating power of the gas supply. But these are matters that certainly require ample consideration.

The Meeting of the Crystal Palace District Gas Company.

THE half-yearly general meeting of the Crystal Palace District Gas Company was held on Friday last, under the presidency of Mr. George Livesey, the Chairman. The Company have done very well during the past year; but yet they have failed to make the amount of their dividend by £2470. This deficiency was reduced by the interest on the reserve fund (£530) being carried to the net revenue account. This method of appropriating the interest obtained on that fund being new, the Chairman entered into an explanation of the circumstances. He stated that, under the old system of Gas Company legislation, the amount of the reserve fund was limited, because it was made up out of appropriations of profits in excess of dividends. Thus the limitation of the amount of the reserve fund to one-tenth of the capital was enacted in the interest of the public; but experience has proved it to be an ample allowance. Under the existing system, there is no limit to the reserve fund, because it is composed of allocations of money that might be distributed as dividend; and hence it belongs to the proprietors absolutely. With regard to the amount of such fund, Mr. Livesey explains that he and his co-Directors of the Crystal Palace District Company see no reason why they should aim at anything more than the old limit. Returning to the subject of the deficiency in the revenue account, the Chairman ascribed it all to the depreciation of residuals; and, descending to particulars, he roundly declared that "all gas companies were suffering from the blundering of "people at Horseferry Road." He denounced The Gaslight and Coke Company, in the plainest and broadest of language, for mismanagement, as will be seen by our report of his address. It is unnecessary to repeat or to paraphrase this indictment, which is, after all, only the

formulation of what is current opinion throughout the British gas industry; but the record will stand for what it is worth. The business of the Crystal Palace District Company is increasing very rapidly, partly as a result of the adoption of the automatic prepayment meter system. The Company's method of financing this system was explained by the Chairman; and it appears to be sound, and well adapted to the circumstances of the undertaking.

Gas and Electricity Supply in Glasgow.

THE annual report and accounts of the Gas and Electric Lighting Committee of the Glasgow Corporation, which are summarized in another column, present a picture of the results achieved by the largest industrial concern existing under municipal control in any part of the world. This is an aspect of the Glasgow undertaking which is not very often considered by those who discuss its operations. It is worth bearing in mind, particularly as this great bulk has not been attained by amalgamation and consolidation, but is a product of growth from a single root. Regarded in this light, it may be said that the Glasgow gas undertaking is the biggest thing of the kind in existence. And—what does not always happen—the management is quite equal to the magnitude of its responsibilities and opportunities. It is the cardinal principle of Scottish municipal gas-works administration that no surplus profits shall be made out of the undertaking; and in Glasgow the administrators sail so close to the wind that their profit balance on the past year's trading was no more than £503, which in a gross revenue of £605,794 is a miraculously close approximation to an exact balance. But even this is too great a margin for the Gas and Electric Lighting Committee, who appear also to have felt seriously hampered by the amount—£120—of the balance brought forward from the previous account. Having, in addition to these bloated balances, realized a profit of £2381 on the electric lighting account, the Committee found themselves in possession of £3004, which they promptly disposed of by transferring £3000 to the account of fire insurance; thus leaving the satisfactory balance of £4 to be carried to the credit of the current year's account. Such financing amounts to genius. With regard to the working of the gas undertaking, there is little to be said. Like all other gas-works administrators, the Glasgow Corporation have to go short in the matter of residuals; but they are buying their coal cheaper than ever. The net result of it all is that the Committee find themselves in a position to take 2d. per 1000 cubic feet off the price of gas, as from the last meter registration; thus bringing it down to 2s. 2d. We heartily congratulate the citizens of Glasgow and the Gas Committee upon this most satisfactory state of affairs, which, it must not be overlooked, is largely due to the skill and devotion of Mr. W. Foulis, the Gas Engineer to the Corporation, and the staff working under him. Gas of well over 21-candle power at 2s. 2d. per 1000 cubic feet is calculated to be a potent factor in the development of the prosperity of Glasgow. The Committee perceive that at this rate there will be a progressively increasing demand for their commodity; and they accordingly anticipate having to provide for large extensions of works. This is hardly the place to comment upon the circumstances of the Corporation Electric Lighting Department; but the report and accounts relating to the two undertakings supply the best possible answer to the foolish and short-sighted criticism that has been published in some quarters with regard to the policy of entrusting these concerns to the same hands.

The Work of the Past Session of Parliament.

THE parliamentary session is over; and whatever may be said of the efficiency of the legislative machine in respect to the transaction of public business, it has worked pretty well upon the private matters submitted to its somewhat cumbrous and decidedly expensive procedure. We have already commented upon the leading results of the session as affecting the interests with which we are more especially connected; but a few remarks may be spared upon the Private Bill Legislation of the year as a whole. The amount of this was distinctly above the average, seeing that no fewer than 180 Bills received the Royal Assent in the period between the meeting and the prorogation of Parliament. It is only fair to add that 104 of these measures were dealt with as unopposed. Much of this parliamentary activity is to be ascribed to the broken character of the preceding sessions, when political changes seriously disturbed the regular functioning of the legislative machine. Some very large railway schemes were to have rendered the session memorable; but none of these came to anything. So far as public interest in the Private Bill Legislation of the session goes, it was a distinctively "water "year." But this aspect of the session has already occupied a good deal of our space elsewhere, and cannot be discussed here. The London County Council were distinguished by much miscellaneous legislative activity during the year; many of their Bills being of an interesting character as indications of the trend of municipal "progress." It is impossible, in any survey of the work of the session from our own standpoint, to omit mention of the passing of the important South Metropolitan Gas Bill, and the rejection of the almost equally significant Dublin Corporation Bill. The former was a proof that Parliament is willing to afford facilities for the development of the statutory gas industry of the United Kingdom in private hands, upon satisfactory lines, and when a clear record of the fulfilment of antecedent duties can be shown. The latter is evidence that senseless agitation against a Gas Company, even when fathered by a Municipality, will not be heeded by the "powers that be." On the whole, a review of the Private Bill Legislation of the past session will show that members of Parliament, both hereditary and elective, have more work to do for the community than appears from the records that fill so much of the space of the daily newspapers—which is well for them, since it cannot be argued successfully that the latter chronicle redounds vastly to the credit of our parliamentary system.

Co-operative Production.

AN interesting statement has been issued by the Labour Association in connection with the annual exhibition of co-operative productions at the Crystal Palace, which was opened last Tuesday. It has become understood that the aims and objects of co-operative distribution have been pretty fully achieved in many instances; so that, as far as this aspect of co-operation is concerned, there is not a great deal more to be elucidated, although there is much more to be done in extending the system and adapting it to the needs of various communities. With regard to co-operative production, however, much preliminary work has yet to be accomplished before its essential principles can be said to be generally understood—to say nothing of their being realized in action on the large scale. According to the statement already mentioned, the first of these principles is "the co-partnership—that is, the "equal partnership—of labour with capital, the system "under which, in the first place, a substantial and "known share of the profit of a business belongs to "the workers in it, not by right of any shares they may "hold, or any other title, but simply by right of the "labour they have contributed to make the profit; and, "in the second place, every worker is at liberty to invest "his profit, or any other savings, in shares of the society "or company, and so become a member entitled to "vote on the affairs of the body which employs him." It is further stated that substantial, though slow, progress is being made in the formation and development of co-partnership productive societies, especially for the past year, under the auspices of the Labour Association. An address by Mr. Hodgson Pratt, on the occasion of the opening of the exhibition, offered some instructive comments on the actual and possible relationship of labour and capital; showing how the co-operative movement in England has been in accordance with the practical character of the English people, which preferred methods of self-help to demands for State aid or to revolutionary agitation. Mr. Pratt demonstrated what the movement has already effected for a million and a quarter members of 1700 distributing societies; but he admitted that this has not touched the relations between capital and labour—the two great factors of industrial production. We cannot accept all that Mr. Pratt advanced respecting the character of these relations, but agree that a true union and amalgamation between the owners of capital and the providers of labour is one of the needs of the age. Another thing wanted is some arrangement whereby the abilities of the great masters of industry, the founders of new firms and of new industries, should be converted into agencies for benefiting the order to which these men belong and the community in general, instead of being mainly appropriated, as is now

too often the case, to the personal and family aggrandisement of these favoured individuals themselves—an end which often fails through the inability of genius, or even rectitude, to transmit itself to a line of descendants. These are large questions, not to be disposed of summarily. It is something that the present generation has awakened to their existence; the next may be able to answer them.

Further Trouble at Chiswick.

It is with regret that we have to plead guilty to deceiving our readers as to the effect of Sir Benjamin Baker's arbitration on the dispute between the fitters and boiler makers at Messrs. Thornycroft's Chiswick yard. It now appears that Sir Benjamin's intervention has, after all, not had the reputed effect of terminating the dispute. The fitters, though not fully satisfied with the award, have resolved to abide by it; but the other party of the boiler makers are greatly disappointed that the Arbitrator did not give a decision more completely in their favour. They gained ten out of the thirteen points submitted to arbitration; but this does not satisfy their ideas of a fair settlement. They also complain that the award is being construed to their detriment; and consequently about 500 of them have struck—thus leaving matters very much where they were before the reference to Sir Benjamin Baker. Upon the last point of this statement of the case—that the award is being construed to the boiler makers' detriment—it is, of course, impossible for any outsider to offer a word of comment, beyond a general expression of disbelief that a firm having so much at stake as Messrs. Thornycroft would so give themselves away, or that the Arbitrator would stand by to see himself so stultified. The patent moral of the tale is the light it throws upon the meaning ascribed by Trade Unionists to the much-abused term "arbitration." They will send their delegates from all parts of the world, as was recently witnessed in Hyde Park, to register a resolution in favour of international arbitration; but when it comes to a question of arbitration upon some twopenny-halfpenny point of their own society's claims, they reserve to themselves the right to set at defiance any award that does not fully endorse their own demands. How can there be any negotiating with people so guided by arbitrary views? They are, in short, much too arbitrary to submit to arbitration. The logic of fact and force is the only reasoning to which they will bow; and it appears to be the application of this only which will save the Chiswick shipbuilding industry from being sacrificed on the altar of the blind Trade Union fetish.

The Lord Chief Justice on Law.

There is actually in progress at Saratoga Springs, in the State of New York, a Law Congress which is honoured by the presence of the Lord Chief Justice of England, who delivered, at the invitation of the American Bar Association, an address, the text of which was given in "The Times" of Friday last. The subject of the address, which was one of the most striking of all the remarkable forensic deliverances that stand to the credit of Lord Russell, was International Law; and this is, of course, a topic that cannot be usefully discussed in these columns. It may be remarked in passing, however, that while Lord Russell proposed as the ultimate aim in the actions of men and of communities conformity with the Divine precept, "Do "unto others as you would that they should do unto "you," he was constrained to confess that neither international nor municipal laws are competent to make the observance of this standard compulsory on all men. It is admitted that law lags behind the suggestions of ethics, to which, in point of fact, it does not defer. As Lord Russell put it, "in England we have an old Constitution "under which we are accustomed to fixed modes of "legislation. . . . Indeed, that habit of looking to "legislation to meet new needs and developments, even in "internal concerns—a habit confirmed and strengthened in "the current century—has done much to restrain the Judges "from that bold expansion of principle to meet new cases "which, when legislation was less active, marked judicial "utterances." This is as much as to say that, though the proverbial tendency of "hard cases" to make "bad law" may be as active as ever, it is better met than it could be formerly by the possibility of speedy legislative redress. To all those who relish a brilliant display of applied learning, clothed in apt language, we can recommend the perusal of Lord Russell's Saratoga address.

WATER AND SANITARY AFFAIRS.

There is to be held in East London a "great demon-"stration," in order to emphasize the letter which eleven members of Parliament from that part of the Metropolis lately addressed to the First Lord of the Treasury on the subject of the water supply. The date for the affair is some time "during the recess," and the place of meeting bears the somewhat ominous title of the "Eastern Empire "Music Hall." The Earl of Onslow is expected to speak on the occasion; and the Conservative members for the Tower Hamlets, Hackney, Bethnal Green, and West Ham are spoken of as likely to attend. The "Daily "Chronicle" describes the coming event as "a Tory demon-"stration," and probably considers that it will not be likely to promote the views of the Progressive party. The fact that the movement is designed for the transfer of the water undertakings to an authority of "a public represen-"tative character," is not enough to conciliate the organ which adulates the County Council. Should the projected meeting take place, it is possible that the Progressives will make their voices heard on the occasion; and the Chairman will find the maintenance of order a difficult task. The tactics of that party in reference to the water question have not been much to their credit in the past; and London is likely to owe them small thanks for any future service. If the Water Board scheme is renewed, the Progressives will try to upset it; and a year hence the Companies may find themselves where they are now. When the County Council re-assemble, we shall hear what is the opinion entertained at Spring Gardens concerning Mr. Balfour's reply to Mr. Lionel Holland; and we shall be informed how the Council mean to go on with their "Bill or Bills" for the purchase of the undertakings of the eight Metropolitan Water Companies. With respect to parliamentary proceedings, a timely reminder of how the Progressives dealt with the East London Water Bill in Parliament in 1894 has appeared in a letter to "The Times," which puts the leading opponents of that Bill in a most ludicrous position. The bare majority of one vote in favour of the Bill alone saved East London from an infinitely worse misfortune than that we are now deploring. Those who are called the "apologists" of the Company have no need to minimize the present suffering; for the Company are in nowise responsible for it. Another fact is now coming very plainly before the public, and that is the monstrous waste of water of which some of the East-enders are guilty. What can be done in this way has been shown by the special correspondent of "The Times." A single tap left running can dispose of 600 gallons in four hours; and as "an indefinite number of East London "taps are never turned off," we get an idea where much of the water goes. But a case the other day at the Thames Police Court is still worse, and shows how one delinquent can waste 2000 gallons of water per day.

Apart from the direct question of waste, which it may be presumed goes on at all times, there is something remarkable, and not yet fully understood, in the effect of the weather on the consumption of water. The increased demand in a hot season cannot be attributed in any commensurate degree to the mere action of thirst. But there is the fact that, while the average water supply of London in 1893 and 1894 was about 190 million gallons per day, the daily average last June was nearly 226½ million gallons, representing a daily consumption of 40·46 gallons per head of the population. In July the pressure was still more severe; the daily consumption exceeding 237 million gallons, and averaging 42·4 gallons per head. We may reckon this at about seven gallons per head over the average for a year, taking 1893 and 1894 as a standard. For 1895 the figures are not yet forthcoming. Concerning the East London Company we may observe that in past years their average daily supply per head has generally been considerably in excess of the like average over all London. Thus in 1881 they exceeded the Metropolitan average per head by more than five gallons per day, and in 1891 they were in advance by at least three gallons. Their ratio declined in the three following years—indicating that the population was gaining upon them; and it is no marvel that in 1893 they sought to extend their works so as to command a larger supply. The need for this has been further shown by the effect of the recent drought, when the supply dropped to a daily average of 30 gallons per head. But though

this corresponds to a total of about 36¾ million gallons per diem, the average daily supply during last month was very nearly 10 million gallons in excess of this amount.

In an able article in "The Times," it is stated that for the constant service in the district of the East London Company a daily supply of not less than 47 million gallons must be available. As the average daily supply last month in the East London district was very nearly 46¾ million gallons, it would seem that there was no very serious deficiency. This would correspond to 38·14 gallons per head daily. But the insufficiency of such a quantity shows itself when we observe that, owing to what we must consider to be the effect of the abnormal heat, the average consumption last month throughout London, including the portion which receives an intermittent supply, was as much as 42·4 gallons per head, or more than four gallons in excess of the East London supply. If we take all London, exclusive of the East London district, we find that the average delivery in July was no less than 43·6 gallons per head daily; thus showing that East London required an additional quantity per day equal to at least five gallons per head. The lesson taught by these facts is that which has been repeatedly insisted upon by engineers and others well qualified to judge—that it is necessary to provide a supply adequate to meet the utmost possible demand, and not merely such as will slightly exceed an average. A rise of 11 million gallons per day in the Metropolitan consumption last month, as compared with June, is a significant fact. Compared with May, the rise in July for all London exceeded 24 million gallons per day; and the supply during May to all London actually averaged a fraction less per head than that given to the East London district in July. We may be asked how was it possible for the East London Company to be giving an average of 38 gallons per head daily in July, when the supply was only 30 gallons per head during the drought? The answer is partly that the supply was not restricted until after the middle of the month, and was not seriously interfered with until the commencement of the last week. But still more to the point is the probability that there was an extravagant consumption, far above 38 gallons per head, before the supply was reduced to 30 gallons. The average of 43·6 gallons in July outside the East London district indicates what may have been the maximum within that area.

In another column of to-day's issue there is an article on "Water and Microbes," founded on investigations conducted by Dr. Klein, the particulars of which are published in the appendix to the recent annual report of the Local Government Board. Dr. Thorne Thorne, in referring to the experiments in question, says Dr. Klein has succeeded in showing that belief in the inability of the typhoid bacillus to thrive in sewage and in drinking water has no sufficient basis in fact. We must say, however, it is very clearly shown that typhoid bacilli kept in raw sewage not only fail to multiply, but ultimately die. There seems something anti-sanitary in the argument which follows—namely, that if drinking water be added to the sewage, typhoid bacilli revive and increase in number. The addition of nitrates to the sewage appears to be similarly acceptable to these particular microbes. Perhaps the practical question is not so much one of sewage *plus* water, as of water *plus* sewage, and the latter in an almost infinitesimal proportion. But it will be more to the point if we consider the experiments relating to filtered London water—that is to say, such water as furnishes the drinking supply of the Metropolis. The unsophisticated reader might be alarmed at the multitudes of typhoid bacilli and cholera vibrios developed in the West Middlesex, New River, and Kent waters. But it has to be remembered that the bacteriologist must first catch his hare. Samples of the ordinary water are taken first of all, and then, in order to make sure of the animal, he is carefully introduced into the water, bottled up, and put into a dark cupboard, maintained at a certain temperature. In other words, the waters are "inoculated" with "recent and actively growing "cultures" of the typhoid bacillus and the cholera vibrio; and in due course there is a fine cluster of colonies, while the actual water supply may be perfectly innocent of any such admixture. Professor Percy Frankland, introducing typhoid bacilli into certain waters, has found them decrease in numbers. But Dr. Klein contends that mere diminution is not sufficient—there must be actual disappearance; and he objects that the examination of only a cubic centimetre of the suspected water is an inadequate test. But we do not observe that Dr. Klein has discovered either the typhoid bacillus or the cholera vibrio in the London water supply. He gets his specimens of these creatures from another source, and then conjures with them. Perhaps it is difficult to say what may be; but speaking of what is, we fail to see anything at all alarming in the present state of the London drinking supply. Some people would like to have more of it just now; and so long as the Water Companies are able to cast out 99 per cent., or more, of the whole tribe of microbes, the chance of a pathogenic organism getting into the tea-cup is too remote to trouble anybody except a philosopher.

ESSAYS, COMMENTARIES, AND REVIEWS.

GAS AND WATER COMPANIES IN THE STOCK MARKET.

(For Stock and Share List, see p. 379.)

BUSINESS on the Stock Exchange during the past week has been very quiet—about the ordinary standard of the holiday season. The markets, on the whole, were sensitive, and liable to frequent fluctuations. At the same time, no powerful influence was at work to cause any strong movement either way; so that changes are of no considerable moment. On balance, they tended downward, especially the hapless American market, which is a prey to political quacks. The Foreign market was a little brighter, and sanguine people bought Kaffirs; but other things were rather poor. The Money Market profited a little by the condition of Wall Street; but it would take a good many Wall Streets to afford it real relief from repletion. Business in the Gas Market was a good bit more active than it had been in the preceding week; the predominant feature perhaps being the demand for good preference and debenture stocks. The latter naturally were strong; and here and there a smart rise was apparent; while the open stocks were for the most part steady and unchanged. In Gaslights there was much dealing in the "A" stock, attended with more fluctuation in price than is often the case; consecutive transactions varying sometimes from 2½ to 3 points. The average was a good medium. The secured issues were brisk and buoyant, commanding nice figures, though they did not actually rise. In the new South Metropolitan stock, a transaction was marked on Saturday at 150—a price which returns less than 3½ per cent. for money. A week earlier it had been 140, which was the figure at which the Company was prepared to supply fractions of stock to proprietors whose holdings needed levelling. Some good prices were marked in Commercials, both for the old stock and the debenture; and the latter had a sharp advance. The Suburban and Provincial Companies were hardly touched, and were quite unchanged, though Crystal Palace was done at top prices. A very fair amount of business was effected in Imperial Continental, mostly at middle figures; but neither it nor any other of the Continental group moved. The rest of the changes included an advance in Buenos Ayres debenture, and a fall in Cape Town and Hong Kong. Transactions in Water were very limited. The tendency, on the whole, was in favour of better prices, though it did not extend to all the Companies throughout the list.

The daily operations were: Gas stocks were rather quiet on the opening day, and quotations were steady and unchanged; secured issues commanding the best prices. East London Water rose 2. The general position on Tuesday was much the same, and prices were good, though Cape Town and Hong Kong fell ½ each. In Water, Grand Junction and Southwark were 1 better. Wednesday was so quiet a day for the big things, that a bit of dealing in San Paulo stood out conspicuously. Quotations were unchanged. Lambeth Water fell 2. Thursday was devoid of all feature generally; but Buenos Ayres debenture rose 1. Kent Water advanced 2. Activity in Gas revived on Friday; business being mostly in Gaslight "A." Commercial debenture rose 4. Saturday was the most active day of the week; but no further changes took place.

WATER AND MICROBES.

THE Twenty-fourth Annual Report of the Local Government Board has been followed, according to the usual plan, by a supplement containing the report of the Medical Officer, Dr. Thorne Thorne; the period covered being the year ended March 31, 1895. Dr. Thorne's report itself is but a limited production compared with the extent of the appendices which follow. Among the latter are five reports by Dr. Klein. One of these relates to the behaviour of the typhoid bacillus, and of Koch's vibrio, in sewage. It is cited as an axiom that the use for drinking purposes of water recently polluted by sewage is, on account of the possible presence in it of the typhoid bacillus, to be by all means avoided. But the remark follows that the view thus generally accepted has seemed recently to be called in question. During the year 1893-4,

Dr. F. W. Andrewes and Mr. J. P. Lawes made many observations as to the behaviour of the typhoid bacillus and the bacillus coli in sewage; the results being embodied in a report to the London County Council. These observers found that the typhoid bacillus, kept in ordinary fluid sewage, has not only no tendency to multiply, but, on the contrary, diminishes in numbers and ultimately dies. On the other hand, it was found that the bacillus coli retains for a long time in sewage its vitality and its power of self-multiplication. Dr. Klein admits that these results, in regard to the deleterious effect of fluid sewage on the typhoid bacillus, confirmed by his own observations on the behaviour of this microbe in sterile sewage, seem at first sight hardly consistent with serious danger from the use for drinking purposes of water that has been subjected to pollution by sewage. But Dr. Klein goes on to suggest that the vitality of the typhoid bacillus in sewage may not be parallel to its vitality in sewage *plus* water of one and another sort. In support of this view, it is mentioned, as established by actual experiment, that the presence in an artificial culture medium of certain earthy salts materially enhances the vitality therein of the typhoid bacillus, and at the same time favours its life processes. Hence the chemical constituents of a drinking water to which sewage gains access may have important influence as regards the risk incurred by the consumers of such water. The nature of the soil through which water percolates before reaching the drinking supply may be such as to afford a *pabulum* for the typhoid bacillus.

In order to test this latter theory, Dr. Klein sought to ascertain how the addition to sewage of nitrates—as representing salts to be found alike in sewage-polluted drinking water and in soil through which sewage matters percolate—tends to modify this medium as a multiplying-ground for certain microbes. From the experiments thus instituted, it appeared that the typhoid bacillus possessed incomparably greater vitality in "nitrate sewage" than in "pure sewage." In the latter, the typhoid bacillus does not multiply, but decreases; whereas in the former sewage it distinctly increases in number. The cholera vibrio is of another nature, and appears to prefer what is called "pure sewage," though there is some exception to this rule.

Another report by Dr. Klein relates to the abilities of certain pathogenic microbes to maintain their existence in water. A belief has been fostered in recent years, founded on "not a few" laboratory observations, that certain pathogenic bacteria, when they have become mingled with large volumes of water, can subsist only for a short time. Here we very soon come to "the parting of the ways." Dr. Klein urges the objection that a cubic centimetre is too small a quantity of liquid to furnish a really trustworthy result. Yet this is the quantity generally dealt with in the culture processes; and as soon as this small amount ceases to yield colonies, the microbe is put down as having disappeared from the total water—as having, in fact, become devitalized. This conclusion, Dr. Klein contends, "is by no means always justified." On this ground, exception is taken to certain observations recorded by Professor Percy Frankland, in which the series of cultures were inoculated with "drops" only of the water to be tested. Dr. Klein argues that unless the "total quantity" of the experimental water be subjected to examination, no conclusion as to total devitalization can be drawn; and it is the total disappearance of the typhoid bacillus from the water which is referred to as the question of practical importance. In the case of a contaminated supply from a well at Worthing, Dr. Klein found, on examining by the culture test, that the particulate matter of so large a volume as 1200 cubic centimetres yielded only a limited number of colonies of the typhoid bacillus. Had only 10 to 50 cubic centimetres been used for the cultivations, no colonies of typhoid need have been found, as only a single bacillus could be assigned to each 200 cubic centimetres of the water. Accordingly, we are told that the various statements which have been made as to the more or less rapid and complete disappearance from a water of the typhoid bacilli or of the cholera vibrios introduced into it, cannot be accepted as supported by adequate evidence. That tests on the limited scale may serve to show the diminution in the number of the microbes is acknowledged; but the point contended for is that the diminution, however great, does not involve their entire disappearance.

One series of experiments deals with typhoid bacilli and cholera vibrios in filtered London water. Samples of the water supplied by the West Middlesex, New River, and Kent Companies thus come under review. The samples were inoculated with recent cultures of typhoid bacilli and cholera vibrios. Speaking of the former, we find that at first the West Middlesex water yielded crowds of colonies per cubic centimetre, and the New River water something like 660,000 per cubic centimetre, while the Kent water yielded only 2500 colonies. Twenty-one days after inoculation, the West Middlesex water yielded about 24,000 typhoid colonies per cubic centimetre, the New River water about 66,800, and the Kent water about 100,000. Five weeks after inoculation, the colonies in the West Middlesex water sank to 1155 per cubic centimetre, and those in the New River to 110; while the Kent water showed 36,000. In eight weeks, the West Middlesex water contained about 50 colonies per cubic centimetre, and the New River water none at all; while the Kent water exhibited about 1000 colonies per cubic centimetre. Some intrinsic difference in the waters is suggested by these experiments. It is offered as an explanation that the longer resistance of the typhoid bacillus in the chalk water supplied by the Kent Company may be due to the presence of lime salts, favouring the vitality and multiplication of this microbe. With respect to the cholera vibrios, these were found to survive for more than five weeks in the water samples. At the termination of the experiment, the cholera vibrios appeared least numerous in the Middlesex water, although at the beginning of the experiment the number of such vibrios found in the water was some thirty times greater than in the water of the New River.

Experiments on cholera microbes in boiled London waters showed that after the lapse of three months the vibrios still survived, and that "abundantly," although undergoing a gradual diminution. As before, the waters experimented upon were those of the West Middlesex, the New River, and the Kent Companies, as representing the Thames, the Lea, and the deep wells in the chalk. Experimenting on the waters sterilized but not boiled, the West Middlesex water was found free from typhoid bacilli and cholera vibrios at the end of 85 days. The result was quite different in the case of the other two waters. When the samples were filtered and sterilized, the decrease both of typhoid bacillus and of cholera vibrio was much more marked in the West Middlesex water than in the New River and Kent waters. Dealing with these waters as taken from the taps within houses, and not subjected to filtration or to sterilization, it appeared that they differed altogether from those Continental waters, normal and non-sterile, in regard to which it is stated that cholera vibrios retain their vitality in them for a short time only. In these London waters, living cholera vibrios could still be detected in a cubic centimetre six weeks after their addition to the sample. The experiments show conclusively that, of the two microbes under test, the cholera vibrio is considerably more hardy than the other.

The results of Dr. Klein's experiments are given in this article substantially as they appear in his reports. Whether the conclusions put forth are in all respects to be accepted, is a matter which seems big with the prospect of a lively discussion. At the close of his report relative to the vitality of pathogenic microbes, Dr. Klein makes a very direct appeal to Professor Percy Frankland to search, by the Parietti method, large volumes of water, instead of using merely those smaller quantities from which he has drawn the conclusion "that Thames water collected at Hampton contained on one and another occasion no bacteria resembling either the typhoid bacillus or the bacillus coli." "Such a conclusion," says Dr. Klein, "which I have no doubt will be referred to over and over again by those who vaunt the excellency of the Thames water for drinking purposes, is in my view unwarranted." Here we seem to find the challenge to a controversy in which Dr. Klein will have to encounter some sturdy combatants, well able to defend their own position. His facts may be admitted; and yet his conclusions on some points of considerable importance may be traversed.

PERSONAL.

Mr. W. Whatmough, the Engineer and Manager of the Heywood Corporation Gas-Works, has had his salary raised to £250 per annum.

Mr. A. S. Gedge, who for many years discharged the duties of Auditor of the Bromley Gas Company, has been elected to the Directorate, to fill the vacancy caused by the death of Mr. J. W. Ilott.

Mr. R. Reeve, who has been for the last forty years engaged as a collector—first to the Phœnix, and subsequently to the South Metropolitan Gas Company—in the district of Blackfriars, has been presented by his colleagues with a clock and ornaments, as a mark of their esteem, on his retirement.

Mr. Perry F. Nursey has been appointed Editor of "Invention." Our readers may remember that Mr. Nursey was President of the Society of Engineers in 1886, and has contributed largely to its Transactions, and to technical literature generally. On the death of Mr. Alfred Williams about two years ago, Mr. Nursey succeeded him as the Hon. Secretary and Treasurer.

OBITUARY.

Mr. Alfred Barton, for many years a Director of the Newport and Cowes Gas Companies, has lately died in his 89th year.

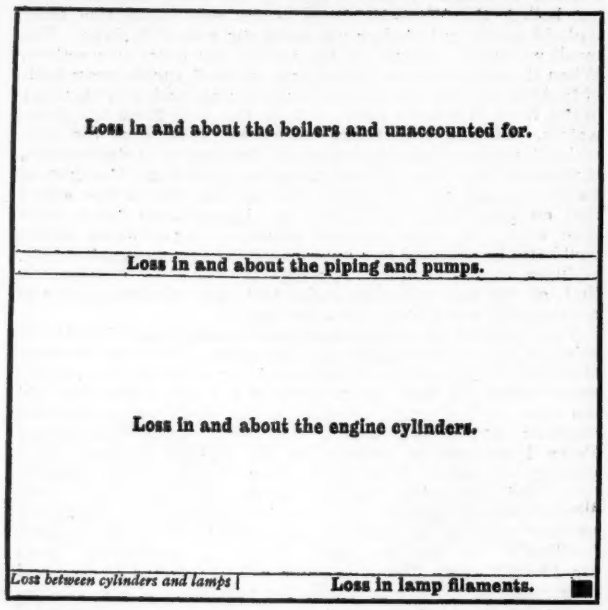
The death took place last Tuesday, in his 50th year, of Mr. Harry Budden, Borough Surveyor of Basingstoke, and Manager of the Basingstoke Water-Works. Deceased was a most estimable burgess and town official; and his death is regarded with the deepest regret in the borough.

The death is announced of Mr. G. A. Thorpe, J.P., the Chairman of the Hastings and St. Leonards Gas Company. It may be remembered that, at the half-yearly meeting of the Company in the spring, Mr. Thorpe, although occupying his customary place, was unable, owing to the state of his health, to address the shareholders; and from the same cause he could not receive the members of the Institution of Gas Engineers when they visited Hastings in May. He succumbed to a long illness on the 16th inst., in his 52nd year. Deceased was a Director of other local Companies; and he had on several occasions been Mayor of the borough. When filling this position in 1875, he was made a Justice of the Peace.

NOTES.

The Scientific Waste of Energy in Electric Lighting.

Calculations have frequently been published with the object of demonstrating, on theoretical grounds, how economically fuel may be used in producing light by electricity. Naturally, the most perfect boiler and steam-engine plant has been taken as the basis for these computations; but it has long been known that, in the practical working of central electric light stations, the duty obtained from the coal burnt falls very short of these theoretical results. In a communication originally sent to "Electrical Engineering," a Chicago journal, Mr. E. A. Merrill illustrates by the aid of a striking diagram, reproduced below,


Loss in and about the boilers and unaccounted for.
Loss in and about the piping and pumps.
Loss in and about the engine cylinders.
Loss between cylinders and lamps
Loss in lamp filaments.

what this practical working means in the light of theoretical possibility. He gives as a typical case a central station equipped with two 140-horse power steam-engines, driving by belts two 90-kilowatt dynamos. Steam is raised in a battery of three boilers, each having 1200 square feet of heating surface. Good bituminous coal, having a calorific value of 13,000 British thermal units per pound, is burnt, and the feed water is heated by the exhaust steam to 210° Fahr. The two engines are only required, on an average, for 5½ hours per day; during the rest of the time of working, one engine and boiler take the load. The average load is 100 kilowatts, and consists of incandescent lamps. The diagram shows the losses and waste of the whole system; the little black spot in the corner representing all the energy that is actually utilized as light.

The Affinity of Rontgen Rays with Light.

The Röntgen rays were taken by Professor J. J. Thomson, F.R.S., as the subject of the Rede Lecture given at the University of Cambridge on the 10th of June, and fully reported in "Nature" for the 30th ult. After explaining the origin of these rays and their properties, as already known, Professor Thomson remarked that the experiments hitherto made on them have not led to any result absolutely decisive as to their nature; but it can be profitably discussed whether the facts oblige us to regard them as due to a new form of energy, or whether these are consistent with the rays being a variety of some form of energy already known. The rectilinea propagation of the rays, their powers of producing phosphorescence and of effecting a photographic plate, and their insensibility to a magnet, suggest that, of the old forms of energy, light is the one to which these rays are most closely allied. We are acquainted with so many varieties of light (meaning transverse vibrations propagated with a definite velocity) with such widely different properties, that we can well contemplate the existence of other kinds with still different properties. There is, for example, the ultra-violet light of very small wave-length, studied by Sir George Stokes, which, though it acts upon a photographic plate, does not affect the retina, and passes through bodies with such difficulty that the most ultra-violet kind is quenched by passing through a few millimetres of air. Then there is the visible light which is able to affect the retina and to pass through great lengths of some substances which are opaque to the ultra-violet rays, though stopped by very small thicknesses of others; and then there are the longer rays of radiant heat given out by a hot body below the temperature at which it becomes luminous. These are not visible, have but little effect on a photographic plate, and are able to traverse substances opaque to both ultra-violet and visible light. Further, there are the waves emitted by vibrating electrical systems, which neither affect the retina nor photographic plates, yet are able to traverse the walls of houses and other substances. Lastly, there is the kind of light discovered by Becquerel to be emitted by uranium salts, which is susceptible of polarization. From this discovery of Becquerel, it may be concluded that besides the vibrations emitted by luminous bodies with which we have hitherto been acquainted, there are others having a much greater frequency, and, it may be, arising in a different way. To sum up, we may say that, though there is no direct evidence that the Röntgen rays are a kind of light, there is no known property of these rays which is not possessed by one or the other of the forms of light. Professor Thomson concluded his lecture by asserting that, by the discovery of these rays, physical science has received an agent which promises to be of the greatest service in investigating some of the properties of bodies which are now most urgently pressing for explanation.

The Temperature of Gas-Flames.

Herr W. J. Waggener has recently contributed a statement to "Wiedemann's Annalen," upon the measurement of flame temperatures by thermo-elements, especially the temperature of the bunsen burner. The experiments were made, as a good many others of the same kind have been before, by plunging various thermo-couples into flames at different points of the combustion area. The highest temperature recorded (1700° C.) was indicated in the lower portion of the external mantle. It is considered, however, that an infinitely thin thermo-element free from conduction would probably indicate in the same place a temperature really exceeding 1770° C. A wire no more than 0·05 millimetre thick still suffers from conduction, and is actually fused in the hottest portion of the flame. Consequently, a more refractory metal than has hitherto been worked into thermo-electric elements is required for these measurements of gas-flames.

COMMUNICATED ARTICLE.

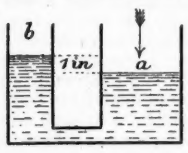
THE THEORY OF THE PRESSURE-REGISTER AS COMPARED WITH THE COMMON GAUGE OR U-TUBE.

By B. R. Parkinson.

Although the branches of the U-tube are generally made of equal bore, it is necessary, for the purposes of this explanation, to assume that they are of unequal areas *a* and *b*; and it will be shown furthermore that the registration of pressure by head of water is independent of these areas.

By the pressure-register is meant a bell or gasholder containing a float or air-tight chamber of even bore, extending vertically throughout the length of the holder; the former being usually made either cylindrical or annular, and concentric with the latter. It is desired to show why, on the introduction of 1 inch of gas pressure in a U-tube, the result is only 1 inch difference in the two water-levels; whereas with the same in a pressure-register, the bell will rise to any height dependent on the smallness of the float section in proportion to that on which the gas pressure plays.

The U-tube may be explained by reference to two principles. The first is that *water always finds its level.* Let us suppose a pressure of 1 inch applied on area *a* in the accompanying diagram—*i.e.*, a pressure equivalent to the support of 1 inch height of water, or 1 cubic inch on every square inch of the area; and let us imagine a solid block of water placed on *a* of height 1 inch. Then, according to the above principle, *a* will sink and *b* rise until a new level is attained. Obviously this will be accomplished by a bulk of water descending in *a* equal to that which correspondingly rises in *b*; each being in volume half the block of water, whose surface then becomes level with the raised *b*. But as the areas are unequal, it follows that the descent of *a* and rise of *b* will be inversely in proportion to these areas—*i.e.*, as *b* is to *a*—the total being 1 inch.



Now, one might at first easily suppose that a pressure equal to *a* cubic inches at *a* would tend to support an equal bulk of water in *b* with lesser area *b*, and consequent greater height $\frac{a}{b}$, which would make the difference in levels more than 1 inch; and as this is what actually happens in the pressure-register, it must be carefully noted. Instead of this, however, as has been shown, it only supports *b* cubic inches, or an amount of water proportional to its area. So that, whatever the two areas may be, the difference in level will only be 1 inch.

A good example is furnished by the storage gasholder. If this throw a pressure of 8 inches, it means that the water-level inside the holder is 8 inches lower than that surrounding it, or the water on the inside of the cup is 8 inches below that outside. The respective descent and ascent of these levels will be inversely as the areas of the inside and outside waters. It is common to calculate the weight of a holder by the displacement of water—*i.e.*, the 8 inches or whatever it may be, multiplied by the area covered by the holder; this representing such block of water as we have above taken to illustrate the pressure.

The second principle which throws light on the U-tube is *the*

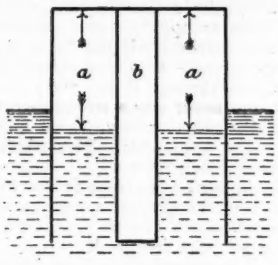
property of fluids to transmit any pressure at any part equally in all directions. Thus the pressure of 1 inch at *a*, being transmitted *equally* in all directions, will be effective at any part of the vessel only in proportion to the area at that part. Hence it is transmitted through to *b*, and there appears only with a supporting power proportional to the area *b*, and will only support a head of water of *b* or any other area 1 inch in height. The converse of this is generally known as the Hydrostatic Paradox.

To sum up the above results, *a* falls $\frac{b}{a+b}$ inches, and *b* rises $\frac{a}{a+b}$ inches. The difference in level is therefore

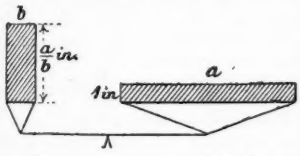
$$\frac{b+a}{a+b} = 1 \text{ inch.}$$

Taking a special case in figures, if *a* and *b* are in the proportion 11 to 1, then *a* falls $\frac{1}{12}$ inch, and *b* rises $\frac{11}{12}$ inch. The difference in level $\frac{1+11}{12} = 1$ inch. We shall see that in the case of the pressure-register, it is quite different. The bell will rise 11 inches, or $\frac{a}{b}$, and the water will decline 1 inch, making a total of 12 inches for 1-inch pressure of gas, or $\frac{a}{b}+1$.

In the accompanying figure, *a* is the area of the gas chamber, which is shown annular; while the float of area *b* is in the centre, and can at once be regarded as a column of water, because the weight of the bell is equal to the weight of water displaced; and any rise or fall means a change in the support equal to the displacement of a part of the water represented by the float.



The bell is initially weighted or floated to the desired level. Suppose 1-inch pressure is introduced in the chamber *a*. This is distributed equally in all directions, and is free to act with effect on both the water and the roof of the bell. Hence its action is *compound*. Firstly, on the water the effect is that of the U-tube; *a* descends and *b* rises inversely as their areas—*i.e.*, respectively $\frac{b}{a+b}$ inches, and $\frac{a}{a+b}$ inches. The difference in levels due to this is therefore $\frac{b+a}{a+b} = 1$ inch.



But the pressure on the roof of the bell is independent of the law of fluids in its effect. This may be illustrated by imagining a common balance with areas *a* and *b*. A bulk of water placed on *a* 1 inch high would support an equal bulk in *b* of height inversely proportional to its lesser area—*i.e.*, $\frac{a}{b}$. The pressure or supporting power is here concentrated through the stiffness of the structure; *not distributed in all directions as in a fluid.*

This is what happens on the roof of the pressure-register bell. The pressure of 1 inch on the area *a* raises the float out of the water until it supports the equivalent of a column of water of *b* area and height inversely in proportion—viz., $\frac{a}{b}$. This power is transmitted through the roof of the bell. The difference in levels due to this is therefore $\frac{a}{b}$ inches. But this $\frac{a}{b}$ is the *sum* of a rise of float and (consequent) fall of water, again inversely in proportion to the areas. Therefore the rise of the float is—

$$\frac{a}{a+b} \times \frac{b}{a} = \frac{b}{a+b}$$

and the fall of the water is—

$$\frac{b}{a+b} \times \frac{b}{a} = \frac{b^2}{a\,(a+b)}$$

Adding these results to those due to the U-tube action, the total rise of the float is—

$$\frac{a}{a+b} + \frac{b}{a+b} = \frac{a+b}{a+b} = 1 \text{ inch;}$$

and the total fall of the water is—

$$\frac{b}{a+b} + \frac{b^2}{a\,(a+b)} = \frac{b\,a+b^2}{a\,(a+b)} = \frac{b\,(a+b)}{a\,(a+b)} = \frac{b}{a} \text{ inch.}$$

We therefore see that, in a pressure-register, the inside water always descends 1 inch for every 1-inch pressure, whatever the areas; and the float rises in proportion to the area of the gas chamber compared with its own. The outside water remains always at the same level. This is obvious, because the rise of the bell only transfers the support from the float area to the gas area, and causes no increase of weight on the total except that of the gas, which is negligible.

Taking a special case again in figures, area $a : b :: 11 : 1$. Pressure on the water of 11 area (U-tube action) causes the float of 1 area to rise $\frac{11}{12}$ inch, and water to decline $\frac{1}{12}$ inch. Pressure on the roof of 11 area causes the float of 1 area to rise 11 inches above the water-line. Of this 11 inches, the float will actually rise $\frac{11}{12} \times 11 = 10\frac{1}{12}$ inches, and the water decline $\frac{1}{12} \times 11 = \frac{11}{12}$ inch. Adding these results together, the total rise of the float is—

$$\frac{11}{12} + 10\tfrac{1}{12} = 11 \text{ inches;}$$

and the total fall of the water is—

$$\frac{1}{12} + \frac{11}{12} = 1 \text{ inch.}$$

By making the float of sufficiently small diameter, an instrument of this kind may be constructed to any degree of delicacy—a mere tube being necessary. Of course, the whole of the material immersed in the water is included in the term "float;" but the volume of the holder itself may be precluded for purposes of explanation, and almost neglected in calculation. The descent of the bell, due to *exhaust*, is only the negative of the above theory; the actual force causing the descent being the pressure of the atmosphere on the roof of the bell—the U-tube action being caused by pressure on the top of the float (representing an area of water), and the direct action, on the annular area. All that is necessary to ascertain the amount a bell will rise or fall for 1-inch pressure or exhaust is to find the areas *a* and *b*. The difference in the squares of the radii of bell and float multiplied by 3·14 gives the annular area; and the square of the float radius multiplied by 3·14 gives the area *b*. $\frac{a}{b}$ is then the rise of the bell, or the magnified inch.

It may be noted that King's gauge, and other instruments constructed on the same principle, come under the heading of U-tubes. The rise or fall of the water-level *b*, which is always less than 1 inch for every inch pressure, is made to represent 1 inch, and magnified to any degree on the scale by mechanical contrivance, according to the required delicacy of the instruments. King's gauge may be easily verified as to its reading by calculating the area of the water on which the gas plays *a*, and that of the float water *b*. Then $\frac{a}{a+b}$ inch gives the rise of the float; and this, magnified by the proportion which the length of the pointer from its centre bears to the radius of the pulley, should agree with the reading on the scale which represents 1 inch.

The Preparation of Improvement Bills.—The Police and Sanitary Regulations Committee of the House of Commons lately presented to Parliament a report, in the course of which they point out that much unnecessary expense and time might be saved by the exercise of greater care in preparing Improvement Bills and in revising them before submission to the Committee, in the light of the evidence to be given by the witnesses. It appears to the Committee to be somewhat doubtful whether in all cases sufficient care has been taken to ascertain, before incurring the expense of a Private Bill, how far the objects to be attained can be effected under the general law or by means of Provisional Orders. The Committee desire strongly to reiterate a suggestion previously offered for the consideration of the House—whether the time has not arrived for the inclusion in a Public Bill of many of the clauses which are so frequently introduced into Private Bills, and which have almost invariably been accepted by Parliament. It appears to the Committee that much trouble and expense might be avoided if the necessity for application to Parliament for such powers by individual authorities were rendered unnecessary.

Manchester District Institution of Gas Engineers.—The 107th quarterly meeting of this Institution will be held at Widnes next Saturday, under the presidency of Mr. Isaac Carr, Assoc.M.Inst.C.E., the Gas and Water Engineer to the Widnes Corporation. The programme issued by the Hon. Secretary (Mr. S. S. Mellor, of Northwich) shows that an interesting day's work has been arranged. The members will assemble at the Central Station, Manchester, at 10.30 a.m., and proceed by train to Farnworth, where conveyances will be provided to take them to the various places to be visited. The gas-works, with their recent extensions and tar plant, will be first inspected; and next, the gasholder station, where a Gadd and Mason holder of 700,000 cubic feet capacity has been erected. From there the members will be conveyed to the Pex Hill reservoir station, where they will be received by the Mayor of Widnes (Alderman Sadler, J.P.), and entertained to luncheon by the Gas and Water Committee. Here the business of the meeting—comprising the election of three members and a description of the Widnes Gas and Water Works by the President—will be transacted. At its conclusion, the Stocks Well and Netherley pumping-stations will be visited; and the day's proceedings will close with tea at the Childwall Abbey Hotel.

TECHNICAL RECORD.

NORTH OF IRELAND ASSOCIATION OF GAS MANAGERS.

The Annual Meeting at Holywood.

We continue to-day our report, commenced last week, of the proceedings at the above meeting.

Mr. W. MILLER (Cookstown) read the first paper, entitled—

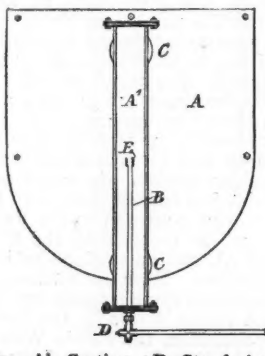
DIFFICULTIES I HAVE MET WITH, AND HOW THEY HAVE BEEN OVERCOME.

The author introduced his subject by stating that he had some hesitation in acceding to the request of the President that he should read a paper at the meeting; but he was encouraged to do so by reading the report of the proceedings of an Association similar to their own in America, in the course of which a young member gave an account of a number of things which had occurred to annoy him in his management of small works. He (Mr. Miller) therefore determined that in his paper he would deal with the difficulties he had encountered, and show how they had been overcome. After hearing the paper, it was quite possible that some of the members might be of opinion that, had they been in the writer's place, they would have adopted different measures. If so, it was to be hoped these gentlemen would place their views before the meeting. He then proceeded as follows.

The first difficulty I have to mention is in regard to the dips in the hydraulic main. The dips in this main were supposed to have a seal of 1 inch; and it had a fixed overflow for tar and liquor, which, of course, meant a tar-seal. The gas was taken off by a pipe on top; and the exhauster was run so that the gauge in connection with the hydraulic main stood at zero. But as there seemed to be greater back-pressure in the retorts than could be accounted for by the 1-inch seal, a hole was bored in one of the lids, and a cock with fitting for a small pressure-gauge was attached. The next time the retort was charged—after an interval of about ten minutes—the gauge was put on the fitting, and the cock opened, with the result that the gauge (a 4-inch one) was almost completely emptied of water, and this with perfectly clear ascension and bridge pipes. The gauge was re-filled, and again attached; and the cock was very cautiously opened, when it showed almost 4 inches constant back-pressure. This pretty well convinced me that there was something shaky about the information received in regard to the depth of seal; but to test the matter further, gas making was discontinued, and the holder pressure taken off. Upon removing the cover from a spare dip, and slowly inserting a lath with a wire nail driven into the side close to one end, it was found that the depth of seal was over 3 inches.

To remedy this state of affairs, my first idea was to lower the overflow two inches or so; but upon examination it was found that this would be very difficult to accomplish, the flange joint on the end of the main being close up to a shaky old gable wall. In fact, the pipe—which was tied on the other side of the gable—acted in conjunction with the hydraulic main as a large tie-rod, to hold the wall in position; the other end of the main going through the opposite gable of the retort-house, and the end flange standing about nine inches out. The danger attending the moving of such an arrangement decided me to drop the idea of lowering the old overflow-pipe; and about this time, when in Todmorden, Mr. Saville showed me an arrangement he had fixed up in one of his retort-houses, consisting of a pipe screwed into the bottom of the main, going down eight or nine feet and then up to a tee placed at the overflow-level. From the top of this tee, there was a connection with the gas-way of the main. Then a pipe was led away from the centre of the tee, which carried away the tar and liquor; and the liquid in the main was supposed to stand at the same level as the bottom of the tee outlet. The tar and liquor had to go in a 1½-inch pipe the whole length of the retort-house; and according to the information received, it did not give any trouble in the way of stoppages. This plan gave a liquor seal.

After giving the matter considerable thought, I had a pattern prepared for a casting shaped like the drawing as shown, with



A. Flange of main. A¹. Casting. B. Stand-pipe with adjusting sleeve C C. Flanges for bolting to cocks. D D. Crosses.

two flange connections; the lower one for tar and liquor, and the upper one for gas. The body of the casting is 5 inches in diameter inside, flanged top and bottom. Two holes were bored in the opposite end of the hydraulic main to that which had the old overflow. To the lower one was fixed a 2-inch full-way flange cock; and to the upper one, a 1-inch cock. To these cocks the casting was bolted. Through the flange on the bottom of the casting, a hole was bored and tapped to fit a 1½-inch iron pipe; and a piece of 1½-inch pipe of suitable length was screwed into it, and secured with a jam nut outside, leaving plenty of thread to attach the other half of a union coupling. The piece of pipe standing up inside the casting when the flange was bolted on, had a large thread cut on it, and a good but easy fitting ordinary sleeve or coupling fitted, so as to allow of adjustment. A blank flange bolted on the top of the casting completed this part of the apparatus.

When fitted at first, the tar-pipe was carried down about 2 feet, and then up 1 foot, so as to form a seal; but as it was found that in the cold winter weather there was a tendency to stop up, a change was made. Now a 1½-inch cross is fixed to the lower half of the union coupling at the bottom of the casting; and from the side of this cross, an 18-inch horizontal piece of pipe is extended. From another cross on the end of this piece of pipe, the tar-pipe is led alongside the main, rising gradually, so that it has sufficient seal at the end where tar and liquor together drops into the tar-store tank. I may mention that the store-tank consists of a very large iron shell boiler, raised on brick and cement piers; the draw-off cock being 4½ feet above the level of the yard, and thus doing away with any pumping of tar except the small quantity from the condensers. An overflow carries the liquor to the scrubber circulating tank. A ½-inch steam-jet is also now attached, so that the whole thing can be blown through if necessary; but since the pipe was re-arranged, there never was a stoppage. If, however, one took place, there is the old overflow, which may be called a sort of safety-valve to the apparatus. The whole thing is very satisfactory; and after being once adjusted, keeps a constant seal of about ¾ inch of liquor on the dips in the hydraulic main. There is a water connection from the water-works fire-main, consisting of a 2-inch pipe, which can be turned on at a moment's notice; but it has never been required.

The second difficulty—irregular working of the exhauster—was partly caused by the man in charge neglecting to keep up a constant steam pressure, or forgetting to oil up at the proper time; and so the exhauster either ran too slow or perhaps stopped. The trouble was that, if surprise visits were paid a few nights running, as soon as this detective duty ceased the gentleman took it easy again. As a remedy for this state of things, the following detective apparatus was invented: A forked or ≻ shaped piece of brass was mounted on an insulated support, on a level with the top of the hydraulic main gauge-tubes—the support being a brass rod about ¼ inch thick and 6 inches long; and the ≻ piece was attached to it by means of a pinch-screw, so that adjustment could be made. An ordinary electric bell was placed on a bracket in my room, with a couple of Leclanché cells in circuit. A wire connected one terminal of the bell with the single end of the brass ≻ piece at the gauge. A short piece of wire connected the other terminal of the bell and one pole of the battery; and from the other pole, a wire was carried to the gauge and attached to the brass button on the top of the float-spindle, this spindle being made of wood. Now it is easy to see that, given the two prongs of the ≻ piece be (say) 1 inch apart, the exhauster working at level gauge, and the ≻ so set on its adjusting-rod that the bottom stands midway between the prongs, a difference in the gauge of very little over 5-10ths will make the button touch one of the prongs; and the moment it touches either, the bell rings. This apparatus is simple and efficient; and the expense is trifling—the whole affair without the gauge costing about 7s. 6d.

Another cause of irregularity in the working of the exhauster—and one which is probably not unknown elsewhere—was the use of an ordinary throttle-valve actuated by the hydraulic regulator in connection with the hydraulic main. This, in our case, was fitted by the makers about 10 feet away from the cylinder of the engine, so that if the valve was entirely closed there was enough steam forward to produce several revolutions; and then when the regulator opened the valve, the engine could not at once respond, on account of the 10 feet of pipe having to get filled with live steam. But even had the original valve been placed in close proximity to the cylinder, I do not think the change would have been of much use, as the ordinary throttle or butterfly valve is not at all suitable for the purpose, on account of the unequal steamway opened at different positions of the lever. This subject is well thrashed out by Mr. Herring in his book on "Gas-Works Construction;" and the remedy I adopted was to get a Bailey equilibrium valve, which, for a given movement of the lever, opens a certain size of steamway, and double the movement of the lever opens exactly double the steamway. The lever on the valve-spindle was lengthened from 9 to 20 inches, allowing much greater movement of the bell of the regulator up or down for a given opening of the valve.

Another alteration made was in regard to lubrication. One of Bailey's sight-feed lubricators was placed right on top of the equilibrium valve; the steam-pipe feeding into a tee connecting between them, so that a constant dropping of oil was kept up, and passed in through the regulating-valve to the cylinder. The

freedom from stiffness in the valve produced by this plan of letting the lubricant to the cylinder pass through it, was found to be a very great advantage. Another small sight-feed lubricator was also fitted to the engine-frame, so that the oil from it would drop upon the piston-rod about half-an-inch from the stuffing-box. Some may think this last useless expenditure, as it is usually supposed that the cylinder oil lubricates the piston-rod sufficiently; but any person in charge of a small steam-engine under constant load, and with the governor uncoupled, can easily prove that it is not so. In our case, there was a hole in the gland of the stuffing-box for oiling; and when oiling up, if the engine was going at such a speed as to keep the gauge steady at zero, the very moment oil was applied to the piston-rod the engine quickened speed, and the gauge would show perhaps 1 inch under atmospheric pressure. Ever since making the before-mentioned changes, the engine and exhauster have worked to our entire satisfaction. All the attention required is a visit by the stoker to the engine-room once an hour; and we can be certain of a steady gauge being maintained inside a 5-10ths inch limit from quarter to full load.

The next difficulty I have to notice—unsatisfactory retort-settings—is one which I fancy most managers meet with sooner or later. Our retort-bench was newly built about six years ago, and consists of four arches—one for one large 16 in. by 24 in. round-cornered ⌂ retort; one for three; and two for five retorts each. The length of the retorts is 8 feet, and the wall at the back end of the arches is 2 ft. 3 in. thick, with a main flue on the top. The bed of three and one of the settings of five were 15 in. by 21 in. round-cornered ⌂ retorts. The other setting of five had the two middles as above; the two bottoms and the top retort being 15 in. by 21 in. ovals. The bed of three was set as follows: Furnace: length, 3 feet; width at bars, 8 inches, widening to 1 ft. 8 in. at the top; depth, about 2 ft. 3 in. The 9-inch arches, four in number, for supporting the top retort, were sprung off the top row of furnace-linings; and large tiles were placed between the arches and the top retort—I presume with the idea of protecting the bottom. Each of the bottom retorts had a 10-inch square flue underneath it; and from the back end of the furnace leading to these flues, there was a cross flue of the same size, close to the back wall of the oven. From the front end of the flues, underneath the bottom retorts, ports ascended to their outer sides; and on top of these retorts, feather walls of 12-inch tiles were placed at an angle so that their upper edges rested against the sides of the arch. At the ends next to the back wall, sufficient space was left to form ports. The spaces between the bottom corners of the top and the two bottom retorts were stopped up air-tight; and on top of this stopping, and quite close to the top retort, a thin wall of brick on edge was continued right up to the crown of the arch on each side—about 10 inches of space being left at the front ends to form ports.

From this description, it will be easily seen that the course of the furnace gases was first backwards to the cross-flue at the back wall; thence to the two flues under the bottom retorts; forward in these towards the front wall of the setting; up through the ports to the outsides between the retort and the arch; then through ports at the back ends of the feather walls; then forward along the top of the bottom retorts; then round the front ends of the two thin brick walls. Here both currents met and passed together along the top of the upper retort, and up through the 10-inch square hole in the crown of the arch at the back end, and so through the damper to the main flue. The two beds of fives were set in much the same way, except that the furnaces were larger; and behind each furnace a cross wall was built about 14 inches from the back wall, with a 12-inch circular hole in it up near the bottom of the top retort, with the object, I presume, of making the heat strike upwards before it started its journey underneath and round the outside of the retorts.

These settings were unsatisfactory for several reasons. One fault was unequal heating of the retorts. The bottoms would be at white (almost melting) heat, and the top, as one of the firemen used to say, "not fit to burn sticks;" and when you come to count up the number of feet the gases had to traverse, I think it is no wonder that such was the state of affairs, as it amounts to something like 32 feet before reaching the top retort, or about 40 feet to the uptake in the crown of the arch. Another fault was that all flues and passages were not capable of being cleaned; there being no possible way of getting at the back of the cross-flues. The consequence was that, at the end of the second year, sufficient draught could not be obtained. The fuel bill was then excessive for the work done; and the make of gas was low. A further fault I found in the settings of five was that after the gases from the furnace passed up through the 12-inch circular hole referred to, and in their passage down toward the back cross-flue, the inner edges of the two bottom retorts were cut clean through before the second season was nearly over; the flame appearing to have much the same action on the retorts as a stream of water would have upon a soft clay bank.

As a remedy for this unsatisfactory state of affairs, I planned and carried out the following changes in the settings: All the retorts were raised up as high as the arches would allow, so as to get a proper depth of furnace; my aim being to try what I could do in the way of generation, or possibly regeneration. The 10-inch square hole in the crown of the arch was closed up, and new uptake flues made in the back wall to the main flue; both joining together before reaching the same. The bottom was cleared out as far down as the drainage would allow, and waste-heat flues built, with secondary air-flues side by side, between the waste-heat and the furnace walls; the lowest waste-heat flue being connected on each side with the uptake flues in the back wall. The furnaces were made 3 ft. 6 in. deep, with a row of nostrils up into each combustion chamber. There were two chambers between the bottom pair of retorts; a thin 4½-inch brick wall resting on the centre of the furnace arch, and going right up to, but not supporting, the top retort. After traversing the length of the setting three times, the secondary air was led under cover to an opening at each nostril of the furnace-arch, just where the gases would enter the combustion chamber. The arches for supporting the top retort (five in number) were of 6-inch arch brick, so as to cover less of the retorts and give more equal support; and they were sprung off the sides of the two bottoms, so that the whole structure would stand firm if all the furnace-linings were removed. A 4½-inch wall—which I have called the furnace-wall—was between the secondary air flues and the furnace linings. The front of the bed was provided with a large cast-iron frame, with two doors, having planed faces and screws with crossbars, to shut up air-tight. This frame had a plating of wrought iron all round and bolted to it. Dampers were placed one on each side in the bottom flues, at the point where the gases leave the setting proper and enter the waste-heat flues, by the adjustment of which the temperature of both sides of the setting could be easily equalized. This arrangement was found of great use, as in our case one of the settings was an outside one. Another damper was placed at the entrance to the main flue, and so arranged that a handle within easy reach of the fireman controlled it; and one rule has been maintained ever since these settings were erected—and that is to close the main damper always before opening the furnace-doors, whether firing or clinkering. The front of the ash-pan was covered with a cast-iron frame and plate; this plate, when cleaning out after clinkering, being removed with a suitable hook. The primary air was led in through shallow flues placed one on each side below the waste-heat and the secondary-air flues, and a steam-jet blower was then fitted so as to play into the mouth of each; the air going back in these flues, and returning in a forward flue to the front of the setting. Three ports made communication underneath the bars on each side; and a two-way cock on the steam-pipe worked the primary air alternately at half-hour intervals. The course of the caloric was up between the two middles and the top retort; then down over the outsides, into a flue underneath the outside half of the bottom retort; and forward to the front. A 4½-inch wall placed under the centre of the retort, with about 15 inches at the front end wanting, made a port for the return of the current to the back end, where the adjustable damper was placed; it being worked by a $\frac{1}{16}$-inch iron rod through a spy-hole.

This was the setting as erected three years ago; and I had fond hopes of how it would turn out, as I thought I had provided for generation under complete control, by the steam-jet injector, and regeneration, with the accompanying saving in the fuel account, more equal heats, and lengthened life of the retorts. But Burns said something at one time about the "schemes of mice and men gangin' aglee;" and many a time during the first year's working of these retorts I thought that the "Immortal Bard" never made a truer remark, for I was totally disappointed. Of course, we were not used to the working of such settings, and consequently for a while were not properly up to adjusting the primary and secondary air; and during the time we were gaining knowledge in the school of experience, the results were no better than with direct firing. But after a time the difficulty of adjustment disappeared; and still results, though very fair, were nothing like what I had been reading about as having been attained elsewhere. In a short time, it was discovered that if all was going well, and the steam-valve was set at a certain fixed opening, the least increase in the opening would deluge the combustion chamber and the whole setting with producer gas, the half of which could not be burned. It can be easily understood that with an inquisitive fireman in charge this sometimes happened, and as often as it did happen down went the heats; or, when adjustment of the steam was made, say, at 30 lbs. pressure, if the said pressure got up to 40 lbs. this also meant putting the primary and secondary air out of balance.

After working most of the first season—sometimes doing well, and at others not so well—a small accident happened to the setting of five. The thin 4½-inch wall resting on the furnace-arch which divided the space between the two bottom retorts into two combustion chambers, collapsed; and when lining the furnace for next season's work, I thought I would try a change. The arch was therefore removed from over the furnace, and what remained of the dividing wall also, leaving a long passage, the full length of the setting and about 12 inches wide, at the place where the furnace-arch used to be; and at this point the secondary air was led in about 6 inches lower down than formerly. The steam-injectors were removed from the lower flues; and the sliding door over the stokehole was drawn to admit the primary air in front (I may here say that this door had been originally made with a view to such a change), and a small jet of steam at slow speed let in along with the primary air to supplement that from the ash-pan. After making these changes and again lighting up, the great superiority of this arrangement was quickly seen. The heats were something

grand; and less than 20 per cent. of the coke produced from Scotch caking coal kept the setting in fuel during constant work. The furnaces are always fired with red-hot coke at the time of drawing.

The same principle has been adopted with the bed of three, with the exception that the current of caloric was made to go twice backward and forward, as described in Hughes on "Gas-Works," latest edition, edited by Richards, and much like that shown on Plate IV. of Richards's "Treatise on the Manufacture of Coal Gas," as applied to five retorts. The two beds—one of five, and the other of three—have been worked for three full seasons, and are now being got ready for a fourth; and I see no reason to doubt that they will last out to the end of the fourth year, as there is not a bad crack in the lot. I ought to mention that, with a view to avoid radiation, the centre of the front wall of the settings was made 13½ inches thick, and built so that it acted like an arch with the crown turned inwards toward the combustion chambers. Near the retorts the wall was bevelled to 9 inches; the result being that with a straight-edge one cannot detect the slightest movement outward. My experiment has convinced me that it would be a great mistake to go back to direct firing; and from the stokers' point of view, the regenerative is unquestionably the best—all being in favour of the present system. The Gas Company also are convinced that the present settings are better, inasmuch as the books show almost £100 more for coke sales than when direct firing was practised; this being an increase of nearly 40 per cent. on the year's working.

My next difficulty—cold-feed to the boiler—was got over in a very simple manner. The exhaust-pipe, 1½ inches in diameter, was originally carried out of the engine-room underground; and then up through the roof of another house behind. The plan adopted was to get a 16 feet length of 2½-inch steam-tube, with a tee fixed on each end. Into the side of one of the tees, the exhaust steam was led; and after traversing this further 16 feet of pipe, it escaped out of the tee at the other end—a short piece of pipe going through the wall to the outside. On the outer end of each tee was fitted a flange to suit; and a blank flange was bolted to each, and the cold-water pipe was carried right through both flanges on its way to the boiler. At one end the water-pipe was secured by jam nuts; and at the other, it passed through a stuffing-box to allow for expansion. The whole thing only cost about 30s., and is a most efficient heater; and sometimes when the feed is increased a bit of steam cannot be seen at the outside end of the pipe, which means that all is being condensed by the feed-water in its passage getting warmed up.

My next difficulty was the liability of the supply of gas to be cut off, should the man in charge forget or neglect to change holders at the proper time. We have two holders, one giving 25-10ths and the other 30-10ths pressure; and when the lightest one was nearly exhausted, the man in charge had instructions to open the outlet of the heavier holder, and shut that of the other—the holder-valves remaining in that position up to about 11.30 p.m., when the make of gas would be greater than the output, and the holder in communication with the working main begin to rise. This was the whole programme; and it was continued for a time. But a change of man introduced us to a rather unpleasant experience. The new broom swept very clean for a week or so; and then it was noticed that he was rather forgetful of instructions, and not careful enough to do exactly as he was told. But the climax was reached in the second week, when, on a Saturday night, I was coming toward the works, and at a distance of about fifty yards noticed the street-lamp flames getting smaller. I suspected at once what had happened; and I do not remember, since my school days, going fifty yards in anything like the time. The idiot had closed the holder that had been feeding the town, and was leisurely making his way to open the other one, when I shot past and nearly frightened the life out of him. I need hardly say that the next place where he found himself was outside the gate. This experience showed me clearly that we were not working in a safe way, especially when it came to a change of man. I thought of having the valves of both holders placed together. But this would have entailed great expense, on account of the distance; and supposing we had connected the valves in the same way as railway points—using levers in a cabin—the cost would have been much the same. At last I thought of the plan I am now about to describe, and which has answered admirably.

To make the description clear, I must explain that the inlet-valves of the two holders are connected by a pipe running from one holder to the other; and the works' main from the meter is connected to this by a tee-piece. The valves—which are hydraulic, with a smooth spindle sliding through a stuffing-box, and fastened by a pin when open—are placed close to their respective holders. We happened to have a spare damper lever and pedestal belonging to the retort-bench; and I noticed that this lever was about the same length as the distance between the inlet-valve of the lightest holder and the nearest guide-pulley. A flat foundation was therefore made, and the pedestal so placed that one end of the lever stood right over the valve-spindle, and the other under the guide-pulley of the holder; the end of the lever next to the valve being connected to the same with a U-shaped piece of iron and a pin. The job did not take more than half an hour to complete; and the man in charge was told to let the holders alone unless the front one went below one sheet. Needless to say, it did not go lower that night, to the very great surprise of the above-mentioned individual; but the look on his face was comical in the extreme when, about 10 o'clock the same night—having been told to go and see if the back holder was full—he came and reported that there were about four sheets lost, and he did not know where it had gone, as the outlet was not open. Of course, it is quite easy to see what happened. When the lightest holder—with the outlet open to the governor—went down to about one sheet, the end of the lever under the guide-pulley was depressed, and the other end, which was linked to the inlet-valve spindle, raised; and the gas then being made passed along with some from the other and weightier holder. The greater the consumption, the more the lever was depressed; and when the consumption fell below the quantity being made, the gas then found its way into the heavier holder as usual. This apparatus I found extremely useful, and in winter it is always kept in operation.

The next difficulty I will mention—discomfort of men while examining retorts—had more to do with the men in the retort-house than with myself. I had often noticed how distressed a man looked after coming out of a retort in which he had been examining or pointing up small cracks, as, on account of the absence of ventilation, no matter whether it was gas or a candle he had, it was both uncomfortable and unhealthy in the extreme. I am not sure that the unhealthiness of the job would have impressed itself so much upon my mind, had I not gone into a retort myself with a candle to make an examination. I need hardly say that my stay was a short one.

One day about this time as I was in the workshop looking for a tool, my glance rested upon a small 40-candle power shunt, wound dynamo of the H-armature type, with which I had been making some experiments; and it struck me that here was the very thing. The machine was a low voltage one—12 volts; and I had a small stock of 10-candle power incandescent lamps, and plenty of wire. I therefore proceeded to rig up the affair as follows: The dynamo was fastened to a piece of plank about 10 feet in length, and the plank spiked down to the boiler-house floor, in line with the fly-wheel of a small inverted launch-engine, which pumps to the scrubber. A few yards of belting completed this miniature generating station. Two pieces of No. 20 double cotton-covered and paraffined copper wire, of the length necessary to reach from the terminals of the dynamo to the back ends of the retorts to be examined, were cut off; and one of the 10-candle power lamps was connected up in circuit. A piece of wire gauze tied over the lamps served to protect it from being accidentally broken; and a short lath tied along about one foot of the wires next the lamp did duty as a handle. This apparatus was found very satisfactory; and with it anyone can go into a retort without the least discomfort. And even if a small engine is not at hand, a fly-wheel turned by a man would supply power enough for one lamp.

The next (and last) difficulty I will mention, is a threatened invasion of the electric light into a power-loom factory. The factory in question uses about 600 lights, is in a low-lying locality, and was supplied from a 4-inch street-main through 315 yards of 3-inch service-main and a 250-light meter; and from the public street to the factory, the ground surface is a very quick down-gradient—the difference in level between street and factory being about 75 feet, or 1 in 12½. We had repeated complaints about bad light, which really meant short supply. The service-main was originally laid for exactly half the lights, and so was the meter. It was explained that increasing the number of lights without providing a larger service-main and meter, was the cause; and an offer was made to the factory management by my Directors, that they would bear half the expense of laying a new 4-inch main by a new route—thereby avoiding the hill, and sending the gas on a practically dead level to the factory.

Negotiations, however, fell through; and the next I heard of the matter was a note from the manager of the factory, asking me to put on full pressure, as they were about to try an installation of the electric light that night—one half being lit with each. He informed me that I could come over if I liked. I know very well that when he wrote the note, he was of opinion that I would not go to see myself beaten. However, I always believe in "facing the music;" and a reply was sent by the messenger, informing the manager that the usual winter pressure would be put on, and that I would do myself the pleasure of calling upon him about 7.30. Upon arrival at the factory, I found half the place wired, and a nominal 16-candle power lamp fitted above each loom. I say nominal on purpose, for I never yet saw a 16-candle power lamp that equalled an ordinary 5-feet burner. I was introduced to the electrical engineer; and the manager asked if I had on full pressure. I replied: "There is no good in our giving you to-night a pressure that we would not keep up. I have on the pressure you usually get when working." The electrical engineer here turned round, and informed me that if I did play any trick in the way of putting on an artificial pressure, he could do the same. I said: "Oh! yes, I know very well all you can do; and if you go very far over proper voltage, you destroy your lamps."

Just then the foreman came to us to say that all was ready. The gas side was therefore lighted up—and that with the old burners of the former year—and in a few minutes the electric side was also illuminated. The townsfolk were there in great numbers; and, of course, everyone crowded to the electric side,

where the electrical engineer could be heard making a comparison, and showing how much better his side was lighted. I stood this for a while; and when he had fairly well pumped himself out, I thought it was time for me to put in a word, so I said: "Gentlemen, you have seen and heard one side of it. Please come with me, and I will show and let you hear the *other* side." We removed to the gas side *en masse*, and then there was a change of opinion; for whereas when the people stood right in the electric section it looked as if that side was really illuminated a good deal better than the gas section, when the position was reversed, what a change! The gas section looked to be at least twice as well lighted as the other. At this juncture, a few ladies had swelled our number; so I said: "Now, ladies and gentlemen, come right to the centre between the two sections, as it is only there that you can make a fair comparison; and I will give you a short lesson in photometry. You noticed how that, when you were in the middle of the electric section, it looked to be best illuminated, but when you went over among the poor despised gas-burners you were surprised to find that the balance was entirely the other way. Now, if you want to compare two sources of light the one against the other, the readiest way of doing so is to place each at an equal distance from the observer. We now have the lights so that this factory is one large photometer."

The electrician was by this time pretty quiet; and I could see that he had not anticipated a turnout like this. The manager here addressed me, and said that if they could have light like that they never would think of making a change. I assured him that he could have as good light all the time if he would leave the matter to me. It turned out that the electrical engineer had fitted the thing up "on spec.," trusting that, when he had got in the thin end of the wedge, he could make his way further. I called a meeting of my Directors; and as they were afraid of a good customer being lost, I had no trouble in getting them to consent to lay a new 4-inch main alongside the old one. A breeches-pipe connected both old and new service-mains before entering the meter; the new service being fed from a 4-inch main in the opposite side of the street. This, while it did not remove the defect of the meter being too small, gave plenty of light; and from experiments made in the same factory at the end of last winter, where one incandescent "C" burner, with a mica chimney and cardboard reflector, was made to light two looms well, it seems as if the mains and meter will be again more than proportionate to the gas consumed.

The last I saw of the electric plant above referred to was when it was being carted to the railway station. I think all will agree with me that the lesson to be learnt from this last difficulty of mine is: "Push, and keep pushing, your business, as a business;" for had I let things slide, and not attended to the matter, I have no reason to doubt that the electrical engineer would have gained a footing, as, from Mr. Preece downwards, they are never weary of depreciating gas, and extolling the benefits of the electric light—talking about how cheap it is, and how many candle-hours should be got from a pound of coal, and so in many cases misleading people who are not awake to their tactics.

And now, gentlemen, as I fear I have already trespassed unpardonably upon your time, I will conclude by saying that I shall be very pleased, as far as it is in my power, to answer any questions or explain anything relating to the paper which may not appear explicit.

Discussion.

The PRESIDENT (Mr. T. Frizelle) invited discussion on the paper; saying he thought it showed that Mr. Miller had successfully overcome his difficulties.

Mr. W. S. STORMONTH (Coleraine) said he thanked Mr. Miller for the intelligence he had exhibited, and congratulated him on the success he had met with. The Association ought to be proud that they possessed mechanical genius such as Mr. Miller had displayed. He (the speaker) must also express his astonishment at the manner in which Mr. Miller had "tackled" the electrical engineer, which he evidently did with some success. Had he not done so, it would certainly have told very much against his Company; and he (Mr. Stormonth) was sure Mr. Miller's Directors must appreciate his services as much as they did now.

Mr. G. CUMMINGS (Ballymoney) said he was more than delighted with the paper they had just heard. He had a familiar acquaintance with Mr. Miller, and knew something of his mechanical genius; and he thought he grappled in a mechanical sort of way—perhaps in some cases a little too much—with every difficulty he had met with. In his (the speaker's) own experience, difficulties with the seal of the dip-pipes often arose; and in his case they had been quite easily remedied. On one occasion, when he had some trouble, he took the steam-pipe asunder, and found that there had been an attempt to cut the dip-pipes, and that a canister had been pushed over the pipe—why, he could not tell; but it was easily remedied. One very formidable difficulty he met with, and he was two years discovering it—he supposed they had better tell their own experiences—was that when a new bench had been built, with new retorts and new hydraulic main, in working with one retort he found that the dip must be very high; whereas when the season of the year came when he had to put on three retorts, he found they were not so bad. When, however, the middle one was taken out, he found he had scarcely any seal at all. He heard a "plump, plump"—something like the sound of a drum at a distance—and he heard it coming down the ascension-pipes of the retorts standing idle. He increased the seal; but next night it was the same. The only way in which he could meet the difficulty in the meantime was by plugging these pipes, so that nothing could get through; but when he had occasion to take the pipes away, he found that his hydraulic main was about 1½ inches out of level. He levelled it, and the matter was remedied. He would like to ask whether the President or Mr. Miller would not be amply rewarded by bringing such papers as this before the meeting, or whether they would feel any more satisfied if they were to receive a gold medal. He considered that the best medal any person could get was the appreciation of his services. The President had spoken about small mains and high illuminating power. He (Mr. Cummings) did not care what the illuminating power of the gas might be, it would be deteriorated to a great extent by small mains. He had had four years' experience of it. The mains that were in the town with which he was connected were put down 43 or 44 years ago, to furnish about one-fourth of the gas they were supplying up to last winter; and he found that, no matter what the illuminating power of the gas was when it left the works, it suffered on account of the pressure at which it had to be supplied to the consumers. Many a time he had kept inside the works, for fear of being annoyed by looking at the gas in the shops. At last he convinced his Directors, and new mains were laid of larger size; 2-inch mains being replaced by 4-inch, and so on. They had now had a season's working with them; and everybody, both consumers and suppliers, rejoiced at the improvement. They had, beyond this, increased consumption amounting to about £100, with very little addition to the quantity of coal used.

Mr. P. J. SALMON (Galway) remarked that there was not so much in the reading of a paper as in the field it opened up for future papers on other points. There was the making of half-a-dozen papers in Mr. Miller's one. It was there that they derived the greatest benefit from meetings like the present.

Mr. MILLER thanked the members very much for the kind way in which they had received his paper, which was the first he had ever read before an Association, and so he was a little nervous about it. With regard to Mr. Cummings's criticism as to the dip-pipes, of course if the main got away from the level that would happen which did occur in that gentleman's case; but his main was perfectly level. The whole thing was too deep. They could hear the "plump, plump, plump," quite loud. The members would all have noticed that there had been a lamentable accident at Forfar, and apparently the arrangement there was a good one; but he certainly could not see how such an accident could have happened, not even after having read the report to the Board of Trade. He had had experience of his bell ringing as often as three times in a night. A manager could not be always there; and it was well to have some method of knowing what was going on in the works, because a great many men thought that what the manager did not see he did not know. He might say that he had in his room a switch whereby he could cut off the apparatus if he did not wish to be rung up.

DISCUSSION ON MR. GIBB'S PAPER.

The reading of the paper by Mr. A. Gibb, of Newry, entitled "Notes on Gas-Burners," given last week, led to the following discussion:—

The PRESIDENT said he thought the members would acknowledge with him that this was a most interesting paper. Mr. Gibb had treated the subject fully from every point. They had all had experience with burners, from those of the old metal type to the incandescent, and the burners of Messrs. Williams and Dean, which Mr. Gibb mentioned. He procured a few dozens of the latter two years ago, and distributed them among consumers whom he was afraid of losing. The consumption was reduced; but instead of losing a consumer he kept one on. In Holywood, they did not spread their burners broadcast, but those who wanted a burner had it free; and if their attention was drawn to any deficiency in lighting, and on examination it was found to be caused by the burner, they gave out a new one. They found this paid them. People were pleased with the increased light, and it was kindly-looking.

Mr. P. J. SALMON (Galway) said the burners they had confined themselves to were Bray's and the incandescent. They obtained several dozens of the latter kind; and the people were perfectly satisfied with them. They had had electric light in opposition for the last five or six years; and their consumption of gas had not decreased, but rather increased. He thought this was on account of their having men going about attending to the consumers. He believed in giving a better light, because he found that thereby they got more money from the consumers. There was no doubt that the incandescent burner was the best they had at the present time. It had given so much satisfaction with them, that the electric light people were not making any great headway. So long as this was the case, there was room for both of them. There was no question that the paper was a very valuable one, as they came in contact with the subject every day. In Galway, they supplied burners free; and they had taken off meter-rents. The Company gave fair play to the consumers; and the latter appreciated such treatment.

Mr. W. MILLER (Cookstown) said it had been remarked that the incandescent burner was the best. He might relate to the

meeting some experiments they made with them in Cookstown. Certain of the Commissioners were desirous of having incandescent burners, while others were not, on account of the cost; and so it was decided that they would get one burner, and put it on a metered public lamp. They wanted to see whether it would cost as much for gas as the ordinary burners, or more. Their method of lighting was rather behind the times. When the moon shone, no lamps were lit. In the ordinary lamps, they had No. 4 Peebles governor burners; and his Commissioners were surprised to find that the consumption in them and in the incandescent "C" burner was practically the same.

Mr. E. STEARS (Lisburn) was very glad indeed to hear the last remark, because at Lisburn they had had some difficulty on the subject. The town lamps were fitted with governor burners consuming 4 cubic feet of gas per hour. Some of the Commissioners wished to put in the new burners; and they fixed two of them on to No. 4 governor burners. They consumed 4 cubic feet of gas; and he considered that the bye-pass took half a cubic foot extra. They had them working six months. The question was whether they were to pay for the burners and the upkeep of them; and on this question they split. Some said there was no saving in gas by using the new burners; while others stated that there would be as much saving as would pay for the mantles and the upkeep of the burners, seeing that they only consumed $3\frac{1}{2}$ cubic feet of gas an hour. But he considered that the bye-pass brought the consumption up to what they had contracted for; so that really there was no saving in gas—the consumption, he found, was the same. What he said was that the incandescent burners gave three or four times the light of ordinary burners, but that half of the saving was spent in keeping up the mantles.

Mr. D. WILLIAMSON (Clones) said Mr. Stears' remark was that the bye-pass consumed about half a cubic foot of gas per hour; while Mr. Miller's was that it consumed the same quantity as the other burner, the bye-pass being on for the whole 24 hours. There must be something wrong there. Did they ever try the caps of Messrs. Williams and Dean? If they tried them on a No. 2 or a No. 1 burner, they would find a great improvement in the light, according to the quantity of gas consumed. He was wondering, with regard to the incandescent burners, whether they gave them away.

Mr. MILLER thought there was a reason why the Williams and Dean burners saved a great deal of gas. It was this—that economical people would not put in a burner which would consume the gas; and this one acted as a retarder, and really burned the gas. They could not convince people that, when they had a No. 1 burner on, they could put on a No. 3; but they could put on a cap, and it used the same quantity of gas. Very likely one consumer would burn as much gas as his neighbour with a No. 3 burner on. As regarded incandescent burners, it was too much to suppose that they all burned half a cubic foot extra per hour. In their case, the care of the burners was not in his hands; and he believed, in looking at the ordinary burners, that while they were nominally No. 4's, they were perhaps No. 6.

Mr. SALMON remarked that there was a good deal in the number. Before he fitted burners, he usually put them on his experimental meter and tested them. In the United States, they had a regulation burner. What he would recommend was that they should use the 3-feet check with a 5-feet burner. In coming to conclusions, they had to take many things into account. The first was the illuminating power they were furnishing to consumers, and the next was the pressure. The question was complicated in so many ways that they had to adopt the methods which suited their location. They had to supply 6 cubic feet of gas per hour; and they were now using No. 4 and No. 6 burners, and were getting very good results. In the case of incandescent burners, they provided them if the consumers found the mantles.

Mr. W. S. STORMONTH (Coleraine) said he had adopted the method of treating the consumers in the best possible way, and giving the most careful attention to complaints. They provided all burners free of charge, and did not even stop at burners. If there were a simple stoppage, or fracture of the gas connection, they repaired it. It was far better to be on good terms with the consumers than not. They now supplied a special Bray burner; and they found it pay well to spend (say) £5 or £6 a year in providing burners, because it satisfied the consumers and the Company also.

Mr. M. MARTIN (Drogheda) said they had some incandescent burners on street-lamps, and they had given great satisfaction to the Corporation. He wanted to extend them, and expected to have 50 of them fitted up. They required to exercise very great care in the matter of shaking the lamp-pillars.

Mr. R. Ross (Dungannon) said they were keeping up somewhere about 12 or 18 incandescent burners. They kept them in their own hands. There was no doubt that they had increased the light a great deal; and many consumers asked for them. The burners were unexceptionable; and there was some hope of getting a stronger mantle than the present one. This would be a great improvement. He found, in his experience, that consumers would not take his burners, because they were of opinion that they would not be correct ones; they would rather depend upon burner men, and pay them a shilling for burners that would give a big flaming light, but were not satisfactory. He worked with 10-10ths pressure, and burned 3 cubic feet of gas per hour in the town; but on the top of the hill the pressure was 32-10ths, and the gas consumption there would be about 5 cubic feet per hour.

Mr. MILLER said their Commissioners had the lighting entirely in their own hands. They put on a new set of Peebles burners for them; and their experience was that they did perfectly well. There was a contract each year for the upkeep of the lamps, which was given to a plumber in the town; and if any lamp became defective, he had to put it in order.

Mr. GIBB, in repiy, said he was satisfied that his paper had provoked some little discussion. At present much ignorance existed among the community with regard to gas-burners; and the more they could enlighten them the better. If the consumers wished for a good burner and they gave it to them, by this means they would extend their consumption, which would be very satisfactory to them as gas managers.

BRITISH ASSOCIATION OF WATER-WORKS ENGINEERS.

Of the papers read at the recent meeting of the above Association, the two which are summarized this week are of great practical importance. They both deal with questions of reservoir construction, and were discussed together.

The first was by Mr. W. WATTS, F.G.S., the Engineer of the Oldham Water-Works. It was entitled—

NOTES ON SINKING, TIMBERING, AND REFILLING CONCRETE AND PUDDLE TRENCHES FOR RESERVOIR EMBANKMENTS.

The author, in commencing his paper, assumes that all preliminary arrangements have been made for the construction of the works. He then shows that to make an embankment water-tight is much more difficult than to make it safe against the pressure of water which it has to sustain on completion. Hidden fissures forming the basement beds cannot always be detected during construction; and the reservoir must be filled before the work can be tested. The searching power of water under great pressure is required to test the stability of the work, and decide its success or failure. It is therefore important that the greatest care should be taken in sinking the trenches, and that none but experienced men be engaged.

To secure a water-tight foundation is the key to the success of the undertaking. Every trench presents difficulties common to itself, which must be dealt with as they arise. To keep sinking without knowing whether the strata are pervious or impervious to water under pressure, is bad engineering; and there is no excuse for constructing works regardless of cost. Judicious expenditure in the foundations of reservoir trenches is necessary; but no expense should be spared in making the work safe and water-tight.

While the base of the embankment is being prepared, and the profiles of the inner and outer slopes fixed, the sinking of the sump should be proceeded with. It should be placed outside the trench, and made sufficiently large to hold the pumps required to deal with the water met with in sinking. The inflowing water is always an increasing quantity as the trench is deepened, and cannot be estimated at the commencement of the works. It is a wise provision to make the sump large enough, and to keep it several feet below the floor of the trench, both in excavating and refilling. It is the receptacle both for water and the cleansings of the trench during the time the work is in hand. The sump should be placed as near the centre and deepest part of the valley as the features of the ground and river admit. Water from both ends of the trench flows each way; and the bottom at this point must be kept low, and made the leading place in sinking, also the lowest place in refilling. When commencing the work, the writer has several times found it advantageous to sink the sump as deep as possible with hand pumps. Sinking in advance in this way gives an idea of the probable amount of water to expect, and opens out for inspection the geological strata for at least 25 feet in depth. Beyond the depth here stated, pumping and hoisting material by hand become costly; and motive power should be employed. It is important that the sides should be well timbered; and this should be put in with a view of taking it out in convenient settings as the refilling proceeds.

The size and kind of pump to fix depend on the height and quantity of water to be raised. It is wise to provide them sufficiently large to cope with a sudden inflow of water during a heavy downpour of rain, and, in case of a stoppage, to empty the trench of water in a reasonable time. As a rule, they have to be kept going day and night for about eighteen months; and after they have once started, there is no time for rest, except while the spare room in the sump is being refilled, or the floor of the trench will get flooded. The author prefers the rotary pump for trench work; and he states its advantages. The casing in which the rotary wheels are placed must be fixed within the limit of the atmospheric pressure from the level of the water to be raised—say, not more than 30 feet. If the height to be lifted be more than 30 feet, the water must be forced the remaining distance by lengthening the pipes above the pump; and, in this way, the limit depends on the power of the engine and the close fitting of the two wheels within the casing. When the height, however, exceeds 50 feet, the writer recommends a second pump, coupled to

the first and placed about 25 feet higher, and worked from the same countershaft, but speeded slightly in excess of the bottom pump. In this manner, he has bottomed trenches 90 feet deep, using good composition belting in the shaft, and double strapping in the engine-shed.

One of the first duties in commencing an embankment is to put down a temporary conduit of wood sufficiently large to convey the maximum flood water from the drainage area appropriated by the works. The length of such conduit is determined by the porous character of the sub-strata forming the base of the embankment, and may have to be made the full width of it. It is important that all the water possible be collected into the trough, otherwise it will find its way into the trench, and have to be pumped out during the time it remains open; thus incurring considerable cost. Great care also is required in fixing it and in making both ends water-tight and firm, to prevent it floating and flooding the trench, which is soon done in a merciless flood. The sides require to be strongly supported, to prevent them bursting outward when running full of water; and, when heavy rain falls during the night, a person should be left in charge to see that no timber or other obstruction interferes with the free discharge of the flood. The expense of a trough bears no comparison with the cost of emptying a deep trench filled with water and mud, with the sides giving way, and the pumps submerged. The trough or bye-pass cannot be dispensed with until the discharge tunnel is completed, and the inner slope of the embankment and puddle trench raised sufficiently high to give the necessary head of water to make sure that the culvert has ample discharging capacity for the flood water. If the reservoir, or series of reservoirs, is intended to be controlled by a permanent flood watercourse, it should, if convenient, be constructed at the outset, and made use of during the formation of the embankment and its contingencies. The trough should have as much fall as the ground permits, to prevent gravel, stones, sods, and tree roots accumulating on the bottom, and reducing its sectional area.

If the time be limited for the completion of the undertaking, the two ends of the trench may be opened out while the sump and other contingent works are in progress. No pumping is required in ground above the level of the stream or brook; but it must be timbered in the ordinary way. As soon as the excavations are commenced in the middle of the valley, the water from the sides falls into the cutting, and must be pumped out. By excavating the ends of the trench some distance into the sides of the valley, a knowledge of a greater length of the geological strata is obtained than necessarily would be the case if the cutting were confined to the level part recently washed by the river. Where plant is no object, it is better to proceed in this way. Great caution is required in pronouncing a trench safe and water-tight, and in ordering the refilling to be begun.

Having commenced the works, they should proceed on lines dictated by experience and sound judgment. Water under great hydrostatic pressure cannot be played with. Whatever the length, width, and depth of the trench, the starting-point below the surface is the sump, from which place the excavations should proceed both ways; as many men as possible being employed to work in tiers, to allow the water to flow freely from them. The excavated material should be deposited in the embankment, the coarser kind being placed at the foot of the outer and inner slope as found most convenient. The sides of the cutting should not be weighted any more than can be avoided; and the timbering should be undertaken by a separate gang of men. Much depends on the nature of the ground what depth each lift the men should excavate. In tolerably firm ground, 4 feet to 6 feet of a face may be allowed; but, when a length is ready for a setting of timber, it should be put in without delay, especially in wet ground. Trenches, as a rule, are made narrower below than above ground. The widening out for the base of the puddle is better left until the refilling has reached the required height. When clay is used for refilling, the trenches are made wider than if concrete be used. The width in both cases is a matter of opinion of the engineer in charge of the work; but for clay it is usually double that of concrete, owing, in the main, to the difference in the cost of the two cores. The difference in the cost, however, is not so great as to surprise one—indeed, it is the other way when the subject is practically considered. Take, for instance, a trench for puddle 12 feet wide and a trench for concrete 6 feet wide. If the excavations be of a mixed character—rock and shale—they would cost for puddle 7s. and for concrete 8s. per cubic yard, on an average, in a trench 60 feet deep. The puddle would cost 4s., and concrete 16s. per cubic yard, or 11s. against 24s.; but twice the amount of excavations and refilling are required in the former, and would cost £44 per lineal yard against £48 for concrete—a difference by no means disproportionate when the advantages of a narrow trench are considered. Indeed, if an allowance be made for shorter stretchers and less labour in handling them, the primary cost of the two trenches, concrete, and puddle is about equal. The time occupied in excavating the narrower of the two openings is less, which is a factor also in its favour.

One of the greatest difficulties in sinking concrete or puddle trenches is to master the springs rising in the bottom. If the joints of rock in which they flow do not lead to the side, they must be carefully piped to it, and protected with a strong casing of concrete. If the flow be prolific, and will rise to the surface, it should be conveyed there and dealt with; but if the pressure be not great, the pipe may be stemmed up after a good body of the foundation has been put in. To make sure that the water has been effectually got hold of, a hole should be drilled about 3 feet deep, and a pipe inserted in it. By caulking the bottom 2 inches with tar banding, the water will rise up the newly-appointed channel; and the remainder of the distance may be grouted with fluid cement, and the whole covered with a body of concrete. It is easy to select convenient places for this important work to be done; and, if carefully attended to, it will give no further trouble.

One source of danger in shaly foundations is to guard against the middle rising, known as "creeps," in collieries. This can be done by putting in the foundation in short lengths before air and water affect the material. This evil is greater in wide than in narrow trenches.

In refilling the trench, it is better to temper or pug the clay at the surface, where there is ample room and light, than to soak and cut it at the bottom, where the room is limited and inconvenient. Moreover, the work of refilling can proceed more expeditiously by having a large body of prepared puddle in stock, than waiting to water and cut it in the bottom. Tempered clay when dropped from the surface goes together much more solidly than if put together dry in layers of 10 inches, and subsequently cut, and is more likely to be uniform in texture, owing to the fact that it can be better selected at the surface. Let fall down each bay or setting of timber, and carefully levelled in convenient layers, a better foundation cannot be put in, nor one in which subsequent settlement is less. The two ends of the trench should be kept slightly higher than the middle of the longitudinal section, to allow the water to drain freely into the sump, and to avoid the accumulation of coarse sediment at the extremities. The ends are the most important places to watch in refilling, and the best of material should be used in covering them up, and layer by layer they should be cleaned, and all the grit washed down from the surface above scrupulously removed. The ends as they near the top-water level need not be as wide as the bottom, where the hydrostatic pressure is much greater; and usually they are narrowed accordingly. On reaching the surface, the ground must be widened out to the full width of the upper section of the trench; and such widening, whether of clay or concrete, must be made in the solid. The width is determined by the depth below the top-water level; from 1 inch to 1½ inches per vertical foot being allowed on each side, starting with a normal width of 9 feet at the top. Thus for a 60-feet embankment, the width at the base would be 60 ft. × 3 = 180 ft. ÷ 12 ft. = 15 ft. + 9 ft. = 24 ft.

The superiority of concrete over clay for water-tight trenches below the surface cannot be questioned; and the cost is practically the same when the difference in the width is taken into account. The refilling can be proceeded with in any part of the trench, and raised as high as necessary when the ground is bad; and if the ends be slotted, chipped, and cleaned, there is no danger in adding additional lengths as the circumstances demand. The concrete should be slobby, and no punning allowed; and it should press well to the sides, to prevent the creeping of water at the back. It should be conducted to the bottom in wooden shoots about 12 inches square, placed at convenient distances, to dispense with wheeling. After a layer of concrete has been spread, it should not be trampled on until it has sufficiently hardened to bear the weight of a man, and then 1½-inch boards should be laid down to walk on. The surface of each layer of concrete should be left as rough as possible for the succeeding layer to grip effectually, and no more grout used than is necessary.

The timbering of deep trenches has to be carefully done to prevent the sides collapsing. In lose or wet ground, the walings should be placed close together; and after the cutting has been made, no time should be lost in completing the framing. Invariably 3-inch deals are used for the walings. The strength of the stretchers depends on the width of the openings, and the nature of the ground to be supported. In many hard rock and shaly trenches, timber is not required unless the beds on one side require supporting. Great care, however, is needed in leaving any part of a trench unsupported; and daily examination is necessary to see that no giving way takes place unnoticed. The timbering should always be well begun at the surface, and in the manner in which it is intended to be continued. Each tier of stretchers, the full length of the trench, should be placed on the same level, and at equal distances apart in ground of equal weight. Walings of 12 feet and 15 feet respectively are convenient for the men to handle, and should be used in the heavier ground with one stretcher in the middle, leaving a space of 6 feet from centre to centre. This space may be too wide in heavy ground, and require an extra stretcher; thus reducing the openings to 4 feet each. An upright deal, placed at each end of the stretcher, must be fixed against the walings to prevent the ends from pressing through in heavy ground, and each stretcher should be "chugged" to keep it in position, and from falling in the event of the ground on one side subsiding. The stretchers should be placed from 18 inches to 2 feet apart, vertically, and cut 12 inches shorter than the width of the trench. Nine-inch stretching timber costs 1s. per cube foot delivered; deals 12 ft. by 11 in. by 3 in., 3d. per superficial foot;

and labour 6d. per square yard in a trench 12 feet wide and 60 feet deep. In other words, the work is charged with 1s. 6d. per cubic yard for timber and 6d. for labour—total, 2s. A travelling-crane placed on a gantry stretched across the valley is very handy for lowering or raising timber as well as the excavations.

The author, in conclusion, says he has endeavoured to epitomize the results of his experience in carrying out large reservoir undertakings, by administration, for the Corporations of Oldham, Ashton-under-Lyne, and Stalybridge, extending over a period of thirty years. During this time, he has had the control of ten reservoirs for the former, and four for the latter Corporations, all of which rank among the best works in the country.

The second paper was read by Mr. JAMES A. PASKIN, M.Inst.C.E., the Engineer of the Halifax Water-Works. It dealt with the subject of

DISCHARGE TUNNELS FROM RESERVOIRS.

At the outset, the author says that where large storage reservoirs have to be made, the subject of outlets requires most careful consideration. When storage reservoirs for gravitation works were first constructed, the mode of discharge, he points out, was nearly always made by carrying a culvert or pipe through and under the made earthwork of the embankment, and in its deepest part. At the present day, this is sometimes adopted, owing to the peculiar nature and lay of the ground. The dangers to this mode, however, are many, and each should be guarded against as likely to occur. To avoid any possibility of the water in the reservoir following the outside of the culvert or pipe, this may be prevented by having iron plates let into the culvert and projecting out some 2 feet or more on the outside, so as to allow them to form a barrier against the water following in a straight course; and where pipes are used, similar iron plates are fastened by means of collars run with lead on the outside of the pipes. When culverts or pipes are so laid, a danger is incurred of the fracture of the pipe or culvert by the unequal pressure and thrust of the new-made embankment above them, or the subsidence or settlement of the ground on which they are either built or laid. This is particularly the case at the point where the culvert or pipe crosses the puddle-trench. All discharge culverts or pipes must be laid in a trench, which is excavated down to the solid (rock if possible), and a foundation of concrete brought up to the required level of the culvert or pipe; the whole to be wrapped round with the concrete, so as to form an outer protection, and relieve the culvert or pipe from any unequal pressure—care being taken to allow the iron plates previously mentioned to project beyond the concrete into the earthwork above. In crossing the puddle-trench, a pillar of masonry or concrete must be built up from the very bottom; and in this pillar one or two iron plates (if the puddle trench is a wide one) must be inserted.

The pipes laid in a culvert may be of the ordinary flange or spigot and socket joints; the culvert with its outer casing of concrete taking off and relieving any external pressure. The culvert should be built of a sufficient size to allow of easy access at any time for the examination of the pipes. Where pipes are laid without a culvert, they should be made of extra thickness, flange-jointed, and fish-webbed; so that, when bolted together, they form a continuous girder. These must only be used in shallow reservoirs—say, of 20 feet deep—where the pressure and outward thrust is small in comparison to an 80 feet or 100 feet embankment.

All discharge-pipes, whether laid in a culvert or naked, should be connected with a valve-tower, built in the reservoir, and approached by a footbridge from the embankment, or better, if possible, from the solid ground off the side of the reservoir. The valve-tower should be fitted with suitable valves to have the complete control of the quantities of water required to be discharged, and be able to shut off the discharge completely. A second valve should be placed on the outlet basin, so as to prevent any waste supposing anything occurs to the inlet valve or valves.

In all cases it should be the duty of the engineer to provide an outlet for the discharge which shall not in the first place stand any risk, by leakage, of damaging in any way the embankment itself; and, in the second place, not to fix any valves which cannot be easily reached for repairs without emptying the reservoir. A mode is now practised (where the conformation of the land admits), from the lowest depth of the reservoir, to drive a tunnel into the hillside inside the reservoir to a point beyond where the puddle-trench it is presumed will end, and there sink a shaft not necessarily in the line of the embankment, but somewhere near. At this point an angle at the shaft should be made, and another tunnel driven; so that its outlet shall be entirely clear of the foot of the embankment—in fact, it should be some 20 feet to 30 feet lower down the valley from the toe of the outside slope of the embankment. The tunnel is generally driven through rock and shale, and should be at least 7 feet in diameter, or an oval shape of equal capacity, so as to allow easy working, and to enable a line of cast-iron pipes to be afterwards laid through. The tunnel being the first work done, it can be used to discharge any ordinary flood water during the sinking of the puddle-trench and forming the embankment; but, in addition, there must be a shoot or trough of sufficient size to pass any sudden storm over the completed portion of the embankment which the tunnel is unable to cope with. This trough or shoot should be raised as the embankment rises in height. The pipes in the tunnel should be laid on iron chairs, and had better be of flanged joints, as lead joints are difficult to run in a small tunnel. These pipes should terminate in the inside of the reservoir in a shallow pit or shaft, and be joined to the upright valve-tower; great care being taken to have a sufficient water-tight stop, to prevent water following on the outside. This pit will form the foundation of the valve-tower, which may be built of masonry, and the stand-pipe fixed inside, to which are attached the valves.

Describing the valves which should be fixed to the upright stand-pipe, the author referred to those employed at three of the Halifax Corporation reservoirs. The stand-pipe itself is 4 feet internal diameter, 1 inch thick, of cast iron, made in 4 ft. 6 in. lengths, and bolted together; the flanges being strongly bracketed. These are faced; and with an india-rubber ring make a water-tight joint. At different heights, numbering according to the various depths that water is required to be discharged from the reservoir, the stand-pipe has, instead of the ordinary 4 ft. 6 in. plain casting, castings inserted, three in number for each valve, of 1 ft. 6 in. The bottom casting has its top flange faced with gun-metal to form a seat for the valve. The middle casting has a series of openings cast to admit the water. The top casting is made smaller (3 ft. 6 in. in diameter), and must be turned and bored perfectly true on its inside for its entire height. The valve itself is simply a cast-iron cylinder, 1 ft. 6 in. in depth and 3 ft. 5 in. external diameter; the outside being turned so as to work inside the top casting already described. The bottom flange must be faced with gun-metal, so as to fit on to the seat in the bottom casting. This gives a play of $\frac{1}{2}$ inch all round for working the valve, as it must pass into the top chamber. This $\frac{1}{2}$-inch space must be made water-tight; and for this purpose a $\frac{3}{4}$-inch diameter india-rubber ring is inserted between the outside of the valve and the inside of the chamber. To fix and remove, or repair if required, the india-rubber ring, and to keep it in its place on the top flange, a wrought-iron loose ring, or, better still, a gun-metal one, is embedded (projecting $\frac{1}{4}$ inch), made in segments, and fastened by gun-metal set screws into the flange itself.

In the case of Halifax, two reservoirs are governed by five valves each, and a third one by three; the object being to be able to draw at different levels, according to the water there is in the reservoir. It has been found that the water is clearer and less liable to sediment if drawn from about 3 feet below the surface. Therefore, if the reservoir when full is 60 feet, a valve should be fixed at 3 feet below top water, and the others at 15 feet apart, so that clear water may be drawn until the last 10 feet, which should be governed by a valve, but only used for emptying for repairs, or in case of severe drought.

As to the working of the valves, a headstock is fixed on the top, which has a gun-metal spindle working inside a cast-iron cylinder, raising or lowering it 12 inches. Two wrought-iron rods pass from the bottom of each valve up the shaft or stand-pipe; and by loose catches are attached to the crosshead on to lugs cast on the outside thereof. The spindle being worked, opens or closes any valve or valves the rods of which have previously been attached to the lugs. So as to get the headstock into a small compass, the rods coming up the shaft are at different levels connected with a crosshead, so as to bring them to the size of the cylindrical crosshead. The whole is encased in a masonry tower with openings to admit the water, and about 2 ft. 6 in. from the outside of the stand-pipe. At each valve, a stage of cast-iron flooring plates is fixed so as to allow access by ladders from one stage or valve to the other. This can only be done when the reservoir is empty, or below the valve which is not working satisfactorily. But in practice it is found that, if the valve does not rest on its seat properly, the stand-pipe being 4 feet inside diameter, anyone can go down, and with a wooden mall drive it on to its face, can repair any rod, and clean, if needed, the face of the seating. With a large number of openings in a 4-feet stand-pipe, it is never necessary to raise the valve more than a few inches for ordinary work.

Discussion.

The PRESIDENT (Mr. D. M. F. Gaskin), having spoken of the completeness of both papers, referred to the question of tunnels under embankments. He said the members no doubt all remembered the disastrous accident in connection with the Damflask reservoir of the Sheffield Water-Works. At that time, the idea was thrown out that it was owing to the pipes of the tunnel passing through the embankment, and that the failure of the joints was the first cause of the accident. He had since been informed that this was not actually the reason; that it was due more to the toe of the bank being placed on unstable material; and that the tunnel had been tested after the accident with something like 20 or 30 feet head of water in the reservoir, and was found to be quite perfect. Since then engineers had endeavoured to sink their shafts into the solid, carry the outlet tunnels from the reservoir through the solid, and so distribute through the valve-tower.

Mr. PASKIN said he did not mention anything in his paper upon the particular point referred to by the President, except this—that originally the discharge tunnels or pipes were taken through the embankment. He did not say that any disaster had

happened to any particular reservoir by these pipes being so taken through. He knew that in the case of the Woodhead reservoir of the Manchester Corporation—the top reservoir in the Longdendale Valley—the pipes through the embankment did give way, and it had to be strengthened and re-lined. Speaking of the great disaster that happened at the Holmfirth flood, that was inquired into with very great care by his late master, Mr. Bateman. His (Mr. Paskin's) opinion was that that was caused by a landslip on the hillside. In this case there was no bye-wash to carry the flood round the reservoir. There was no waste weir on the low side of the embankment; but there was a shaft which acted as an overflow. He did not recommend running the pipe right through the embankment; but he certainly agreed with the modern plan of taking the tunnel into the hillside—clean away from the reservoir—and bringing it out some 30 or 40 feet below the toe of the embankment.

Mr. O. J. KIRBY (Batley), directing attention to the statement contained in Mr. Paskin's paper, "that the water is clearer and less liable to sediment if drawn from about 3 feet below the surface," &c., said he might emphasize that, having proved it himself. He would further say that, if all reservoirs had been treated in the admirable way in which Mr. Paskin had treated his at the outlet, they would not hear so much of lead poisoning in the West Riding and Lancashire district. As to the President's remarks, Mr. Paskin had not referred to the Damflask reservoir, but had stated what happened to the Bilberg reservoir, the property of the Holme Valley Commissioners, some three miles south of Holmfirth. The explanation that Mr. Eaton had given to the President as to the accident to the Damflask reservoir was the correct one.

Mr. W. INGHAM (Torquay) thought some of the figures in Mr. Watts's paper were rather misleading. The cost of excavations was put down for puddle at 7s. and for concrete at 8s. per cubic yard. He knew a case in which the cost was much higher than this. With regard to the cost of puddle, in some work they had recently been doing, it had been as much as 15s. 6d. per cubic yard. As to the timbering of the trenches, the author stated that 3-inch deals were invariably used for the walings. That was hardly correct; 4-inch and even 6-inch were often used in bad ground. The cost of timbering trenches was put at 2s. per cubic yard of excavation. In some work they had been doing, it had been as much as 3s. 5d.—in fact, the timber and timbering had cost £3000, or one-sixth of the total outlay on an entire dam. Regarding concrete, he differed from the author as to punning. He believed the air could be got out better by slight punning, and the strength of the concrete increased.

Mr. R. E. W. BERRINGTON (Wolverhampton) remarked upon the immense value of the paper read by Mr. Watts, seeing that it came from a man with thirty years' experience of such work. As to Mr. Ingham's observations, the cost of wood would, of course, vary in different districts.

Mr. WATTS, in reply, said he thought 7s. and 8s. per cubic yard for sinking trenches was ample. A great deal depended on the character of the material to be dealt with; but, in all the trenches he had sunk for Oldham and the Ashton and Stalybridge Corporations, they had not exceeded this estimate. Of course, if they went down more than 60 feet, the probability was that the figures mentioned would be increased. As to the cost of puddle, he maintained that 4s. was sufficient; and he was astonished to learn that as much as 15s. 6d. had been paid. Of course, if they had to fetch the puddle from a great distance, he could understand it would cost a good deal more. With regard to concrete, in a trench 6, 9, or 12 feet in width, he should not expect the cost to be more than he had quoted. He was speaking of hydraulic lime concrete. If they used 4 to 1 hydraulic lime with properly crushed stone, and 5 to 1 cement, there was not much difference in the cost. All the trenches on the Oldham Water-Works had been filled with concrete; and not one of them had exceeded 6 feet in width—one was 5 feet wide, and 119 feet deep in the lowest part. With regard to air, they could not eliminate it from concrete in a slobby condition, whether it was punned or not. Of course, where they had a trench 10 or 12 feet in width, there was a greater margin of safety; but even in trenches of this kind, he certainly should prohibit punning. It was different where a superstructure had to be built on concrete foundations; punning might then be necessary. But he never practised it, even for their valve-shafts, rising 75 feet in height. They had seventeen reservoirs in operation, and not one of them was a failure. With regard to the walings, they could be put as thick as one liked; and they were 11 in. by 3 in. in the main. Instead of putting in thicker walings (which would require considerably more handling, and would be more costly), he would put in an additional stretcher where it was required. Of course, a great deal depended upon the uprights used. Regarding Mr. Paskin's suggestion that the drawing-off valves should be about 3 feet below the surface of the water, his experience was, with domestic supply reservoirs, that the upper 15 feet was the working capacity—that was, in dry weather, the water would rise and lower about 15 feet; and therefore a valve placed so near the surface would be of very little use. It was a proper thing to have frequent drawing-off points. But he thought the first draw-off was amply near enough at the line of 12 feet below the surface; and the other outlets should come in the same order, until they reached within a certain distance of the bottom. The water in the last 15 feet or so of the reservoir was not of much use for consumption. He was not quite at one with Mr. Paskin in putting in two valves—the back valve and the front valve—with a view of avoiding the emptying of the reservoir. The water of the reservoir must be drawn off before they could do anything with it. He knew these valves were used in many reservoirs; but personally he did not see where the good of them came in. Something was added to the cost; and additional room had to be provided in the valve-shafts. He also thought it a mistake to put the valve-shafts into the reservoir—at any distance, at all events—for this simple reason: The elevation of the valve-shaft required to be made absolutely water-tight, or the fittings within could not be got at; and when the elevated shaft was exposed to the pressure of the water, they had a difficulty in making it water-tight, besides which considerable cost was involved in building a bridge to approach it. He further thought there was danger in leaving in a block of material purposely to support the discharge culvert. It supported the pipe; but that could be done by concrete.

A vote of thanks was passed to Messrs. Watts and Paskin for their useful contributions.

THE DECOMPOSITION OF HYDROCARBONS BY HEAT.

The papers of which the following is an abstract translation form with those on the "Combustion of Illuminating Gas in Cooled Flames and Gas Motors"* the academical thesis of Dr. Fritz Haber for the chair of technical chemistry at Carlsruhe. The thesis has been published as a monograph(†), and has appeared in some recent numbers of our contemporary, the "Journal für Gasbeleuchtung."

I.—*Prefatory Survey of the Subject.*

The changes which fatty hydrocarbons undergo at high temperatures have been little studied, notwithstanding their importance to the gas industry. Experiments on the quantity, composition, and illuminating value of the gas from a given weight of raw material have been numerous; but owing to the difficulties attending the research, experiments covering the whole field of the products and course of the decomposition are wanting. The complexity of the gaseous mixture, and the amount of tarry products formed, are the chief obstacles to investigators.

In the aromatic series of hydrocarbons, Berthelot has made some exhaustive researches; but he has not been so successful in his investigations on fatty hydrocarbons. In one set of experiments, he heated the gas under examination in a retort; and in another set, he passed it through a heated tube. He believed the effect on the gas to be the same in either method; the prolonged exposure in the retort compensating for the higher temperature in the tube. The assumption is quite arbitrary, as in the retort the primary products are in a position to be acted upon; but in the tube, this is not necessarily the case. He found in the retort that ethylene and hydrogen formed ethane; ethane formed ethylene in small quantities; acetylene and hydrogen formed ethylene; ethylene alone gave traces of acetylene and ethane; while acetylene and ethylene disappeared in equal amounts from a mixture of the two, liquid products chiefly consisting of a body of the formula of crotonylene being obtained. In the heated tube, he found that methane yielded acetylene, olefines, ethane, naphthalene, and tar; while amylene and pentane gave similar products and higher and lower paraffins.

From these rather scanty data, Berthelot deduces a set of laws of the transformation of the fatty hydrocarbons by heat. He believes that carbon is separated only when compounds are built up by the heat; and that, by progressive splitting off of hydrogen, more complex hydrocarbons result. The building up and breaking down of hydrocarbons are mutually repressive, because the higher hydrocarbons formed break down, and the lower ones combine to higher. The result is an equilibrium of a great number of hydrocarbons, as shown by the following equations for the action of heat on methane:—

(1) $2CH_4 = C_2H_4 + 2H_2$ (2) $2CH_4 = C_2H_2 + 3H_2$
(3) $C_2H_4 = C_2H_2 + H_2$ (4) $C_2H_2 + H_2 = C_2H_4$
(5) $C_2H_4 + H_2 = C_2H_6$ (6) $C_2H_6 = 2CH_4 + C_2H_2 + H_2$

Both in the building up or breaking down of hydrocarbons, free hydrogen may be an agent, or there may only be several hydrocarbon molecules.

It will be seen that these laws were deduced by Berthelot from the study of the secondary, rather than primary products of reaction; as under the conditions of his researches he could scarcely hope to secure the primary products, though these are of special importance in tracing the course of the transformations. His assumption that carbon does not result by the breaking down of hydrocarbons is groundless, as, though the tar becomes denser and more carbonaceous the higher the temperature of production, yet it always contains hydrogen; and it is not proved that the whole of the carbon results by successive splitting off of hydrogen and condensation of the residues, and that direct decomposition of the hydrocarbon

* See "JOURNAL," Vol. LXVII., pp. 510, 562, 622, 749, 806.

† "Experimental-Untersuchungen über Zersetzung und Verbrennung von Kohlenwasserstoffen," von Dr. Fritz Haber. Munich: R. Oldenbourg; 1896.

into carbon and hydrogen, followed by polymerization, does not also take place. Likewise the recognition of a number of compounds formed by the addition of hydrogen to, or its removal from, a few of the lower olefines and paraffins does not warrant the conclusion that there is an equilibrium between such additions and removals, and is not a sufficient basis on which to establish a general theory of the action of heat on the fatty hydrocarbons. Decisive evidence against the theory is the fact that the immense multitude of bodies which it requires should be formed is not actually observed. For methane, Berthelot ends his equations with ethane as the most complex final product; but, according to his theory, many other more complex products are to be expected. The most striking point in the equilibrium theory, as exemplified in the case of methane, is the part played by acetylene. It is inconceivable how it can form an important link in a chain of reactions of purely fatty bodies, when it had been observed by Berthelot himself that it was readily converted to aromatic compounds.

Berthelot's views influenced Vivian B. Lewes, though from the equations expressing the decomposition of various of the lower hydrocarbons given in a paper on "The Action of Heat upon Ethylene,"* the latter appears to have rejected the equilibrium theory, and to consider the reactions to be chiefly destructive. Building up occurs only in the polymerization of acetylene, and in secondary reactions of other hydrocarbons. Lewes, however, attaches even more significance to acetylene than Berthelot did, as may be gathered from his paper on "The Luminosity of Coal-Gas Flames."† With gas aspirated from various heights in a luminous flame, he found the amount of acetylene increase and that of olefines decrease steadily up to the lower edge of the luminous zone. The heavy hydrocarbons decomposed in that zone, therefore, consisted chiefly of acetylene. He determined the temperatures of the different zones, and then passed the various component gases, either alone or diluted with hydrogen, through tubes heated to the temperatures found. He thus ascertained to what extent acetylene was formed, and arrived at the following equation for the action of heat on ethylene: $3C_2H_4 = 2C_2H_2 + 2CH_4$. The acetylene produced polymerizes to benzene and higher compounds; while the methane breaks up according to the equation: $2CH_4 = C_2H_2 + 3H_2$. The acetylene does not yield carbon by polymerization only, but gives a temperature in the luminous zone of a gas-flame exceeding that at which it is directly broken up to carbon and hydrogen. Lewes, equally with Berthelot, is under the obligation to prove that acetylene is found among the products of the decomposition of methane in the quantities his equations demand; and he has further to cope with the definite statement that nascent acetylene passes directly into tar and carbon.

It may be pointed out parenthetically that Lewes's theory of the luminosity of flame has an important defect. He appears to consider that heavy hydrocarbons, gaseous at ordinary temperatures, are responsible for the light of the luminous zone; and if such is the case, the preponderance of acetylene just below this zone would give it immense importance. But it is not proved that hydrocarbons gaseous at ordinary temperatures do furnish the carbon to the luminous zone. Berthelot's view of the formation of carbon by the action of heat on hydrocarbons is opposed to this assumption. He considers that the cold gas issuing from a burner is heated by the margin of the flame, in which combustion has produced a high temperature, and is consequently decomposed into gaseous and tarry bodies, the latter of which are naturally in a state of vapour at the flame temperature. By greater heating, carbon is split off from the tarry bodies, and radiates light. It has, however, already been indicated that Berthelot's view, that carbon separates through polymerization only, is untenable. If Lewes merely contended that there was separation of carbon from acetylene as well as from high-molecular gaseous hydrocarbons, nothing could be adduced against his view. But he is certainly in error when he holds that the separation of carbon occurs only from the decomposition of acetylene, which is undoubtedly the view he has adopted in recent publications.‡ Though polymerization is observed in all decompositions by heat, he does not consider that it accounts for any of the luminosity of the flame. It may be shown that there are tarry constituents in a flame, by holding a cool dish in it so as nearly to extinguish it, when the dish gradually becomes coated with tar from the non-luminous part of the flame. That there are tarry constituents even in the luminous zone is shown by analyses by Stein.§

Lewes's theory remains improbable so long as it is unproved that the tar in the flame is converted to acetylene before it is decomposed to carbon and hydrogen. Naphthalene and many other heavy hydrocarbon vapours have not the necessary proportion of hydrogen in the molecule for them to break down to acetylene without separation of carbon. Nothing appears to be gained by assuming an intermediate formation of acetylene, though Lewes considers that, as an endothermic compound, it imparts on decomposition a very high temperature to the carbon particles. The heat absorbed in its formation in the lower part of the flame is liberated when, after a brief existence, it is decomposed in the luminous zone. If such be the course of events, the decomposition does not occur in the nascent state; or, on the other hand, if it does, heat is absorbed and restored simultaneously at the same spot, and for the thermal and optical conditions of the flame the intermediate formation of acetylene is quite immaterial.

Apart from their bearing on the luminosity of flames, Lewes's researches on the behaviour when heated of the lower paraffins and olefines are valuable. Speaking generally, Berthelot's views on the decomposition by heat of the lowest fatty hydrocarbons are incorrect, as will be shown in the sequel. For the present research, normal hexane was selected as a typical subject for several reasons. The breaking down of the molecule may occur without any splitting off of hydrogen—as, for example, $C_6H_{14} = C_5H_{10} + CH_4$—and such decomposition could only be studied in paraffins of larger molecules than methane and ethane. These latter hydrocarbons require a high temperature for their decomposition; but the higher members break up at incipient redness, and at this low temperature secondary reactions are improbable. Hexane, in particular, was chosen as likely to be readily transformed to benzene, if the suggestion of Armstrong and Miller that the higher fatty hydrocarbons passed directly into those of the aromatic series was well founded. It was specially interesting to learn the relative quantities of fatty illuminants and of benzene yielded by it; it being technologically important as the chief constituent of gasoline. Benzene is, according to Bunte, the most efficient enriching material for gas (acetylene, perhaps, equals it); but gasoline ranks next. It was desirable to learn if the value of the latter depended on a considerable formation of benzene from it when heated.

Hexane has formed the subject of some experiments by Andrews and Norton;* but they were by no means exhaustive. Prunier, also, has examined the amounts of olefines obtainable from fractions of gasoline. The researches now described show that the fundamental reaction in the decomposition of hexane and trimethylethylene is not a splitting off, but a transposition of hydrogen, and a breaking up of the original molecule into smaller ones. In the fatty series, the carbon-hydrogen bond is stronger than the carbon-carbon bond; though the converse is true in the aromatic series, as is shown by the conversion of benzene on heating to diphenyl and hydrogen. The higher fatty bodies are comparatively easily broken up into lower molecular bodies, by the opening up of the carbon chain, and the transposition of the hydrogen. Breitenlohner reports to a similar effect on the modern cracking process, by which he obtained only 8 per cent. of gas, consisting of methane, ethylene, hydrogen, carbonic oxide, and acetylene. Vohl, on the other hand, found only hydrogen result when he subjected several of the higher hydrocarbons fractionated from American petroleum to the prolonged action of a very high temperature. The results of Thorpe and Young on the paraffin distillation, those of Engler and his pupils on brown coal and paraffin oils, and of researches at Riebeck's works are confirmatory.

The position at which rupture of the molecule takes place is, according to the present researches, different to that found by Thorpe and Young. By superheating vapours for a short period at high temperatures, it was found that simple terminal members were split off; whereas Thorpe and Young found the rupture take place about the middle of the molecule. In the higher residue (if a double bond was not previously present), a double bond is found owing to transference of hydrogen. Thus hexane behaves according to the equation $C_6H_{14} = CH_4 + C_5H_{10}$. The researches of Armstrong and Miller on the matter condensed from oil gas lead to a similar conclusion. They found among the fatty products only traces of higher paraffins, but an abundance of olefines. Whether the lower residue split off consists of methane, ethylene, or acetylene depends on conditions still needing investigation. Apparently, however, hydrocarbons containing fewer than three carbon atoms are invariably produced when vapours of fatty hydrocarbons are heated for a short time at high temperatures; and evidently those with two double bonds are formed in but trifling amounts. Crotonylene is yielded in small quantity by the splitting off of methane from amylene. This is substantiated by Prunier's observation that it was necessary to heat at least 10 grammes of gasoline to obtain evidence of crotonylene, which is readily recognized, among the products.

The fundamental reaction is readily seen on heating hexane vapour for about two seconds to 600°–800° C. Free hydrogen is scarcely split off at all; and its addition to the olefines is equally limited. The addition of hydrogen to acetylene, which is the hydrocarbon most prone to it, takes place very slowly at that temperature. The primary products of decomposition are preserved under these conditions, and may be estimated. With trimethylethylene, the decomposition products are only partially secured. Methane is found as such; but the higher residues recombine to form more complex molecules. This condensation of the free unsaturated residues constitutes the other phase of the changes which hydrocarbons undergo when heated for a brief period, and is at the root of the reactions by which compounds are built up by heat. Both sets of reactions may be summed up thus: Low initial terms of series are split off, and form the gaseous products, while the higher residues combine together. The reactions are not mutually restrictive; neither is an equilibrium established, as Berthelot supposed. The

* See "JOURNAL," Vol. LXIII., pp. 329, 381, 436.

† See "JOURNAL," Vol. LIX., p. 795. ‡ *Ibid.*, Vol. LXV., pp. 1067, 1305.

§ See "Journal für Pract. Chemie," 1874, p. 401.

* See "American Chemical Journal," Vol. VIII., 1-8.

bodies destroyed are not those which are built up, but are of quite a different set.

Between 900° and 1000° C., these simple relations disappear. With hexane, the primary products are no longer all stable; and the secondary reactions obscure the primary ones. The products formed by the combination of the higher residues pass, through the splitting off of hydrogen, into more complex tar-like forms. Separation of hydrogen is found, and the Berthelot-Lewes special case—the decomposition of the simplest members of different series—is illustrated. The result of an examination only throws light on the ultimate products. The gases set free have the same components as illuminating gas; while at lower temperatures, others are also found. Mathematical considerations and analytical results show that a portion of the gas formed at low temperatures, which was formerly falsely supposed to consist of homologues of methane, in reality belongs to a group of hydrocarbons poorer in hydrogen, but resembling the paraffins in their behaviour during analysis. Possibly it is the trimethylene group.

Hexane is shown to have no specific tendency to form benzene; and, contrary to the conjecture of Armstrong and Miller, since hexane and trimethylethylene furnish equal yield of benzene, it seems likely that this body is formed solely from a simple product—probably acetylene—which splits off from both these hydrocarbons. The property possessed by acetylene, of easily forming at dull incandescence aromatic compounds (fatty ones with difficulty), supports this view. A comparison of the weights of gaseous olefines and benzene, shows that the gas produced at a dull red heat certainly owes its carburetting value largely to the olefines. The ratio of the carburetting power of ethylene to that of benzene, for equal weights, is, according to Frankland and Knublauch, as 1 : 2; and according to Bunte, as 1 : 2·5. Bunte, whose unpublished work on the subject has been at the author's disposal, found that one Hefner unit per hour was furnished by 1·5 grammes of ethylene or 0·5 gramme of benzene. On the fair assumption that, weight for weight, all the olefines have a carburetting value about that of ethylene, it follows that the whole of the benzene plays an unimportant part as a carburetting agent, compared with the gaseous olefines in the products of the decomposition of hexane and trimethylethylene at 600° to 800° C. The ratios, however, become altered when the temperature is 900° to 1000° C. The amount of benzene is considerable, and has a carburetting value equal to that of all the olefines, of which ethylene now forms the chief part. On the practical scale, the ratios are scarcely so much in favour of the benzene; but, in any case, it must have the credit of a considerable fraction of the total carburetting value of oil gas produced at the higher temperature from gasoline. It has been found that benzene ceases to be stable between 900° and 1000° C., so the amount of benzene formed from hexane and trimethylethylene at higher temperatures is naturally less. An auxiliary investigation furnished a simple method of estimating ethylene and benzene in illuminating gas.

Fire Risks from the Leakage of Electric Current to Earth.—The Society of Arts have offered the Fothergill prize of £25 and a silver medal, for a paper on "The Best Means of Effectually Preventing the Leakage of Current to Earth, in Electrical Installations, from Generating Heat and Setting Buildings on Fire." The paper is to be prepared with the view of its being read and discussed at an ordinary meeting of the Society.

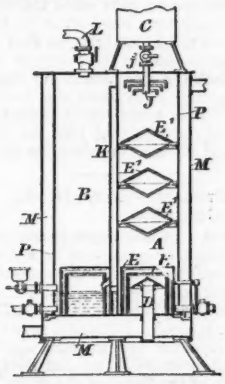
Next Year's Examinations in Gas Manufacture.—The "Programme" of the Technological Examinations of the City and Guilds of London Institute for the session 1896-7 has been issued; and it will be found specially useful to those of our readers who purpose presenting themselves next year. The examinations will take place on May 4, 1897, from 7 till 10 o'clock. The questions to be set by the Examiner (Mr. Alfred Colson, M.Inst.C.E., of Leicester) will be similar to those in previous papers in both the Ordinary and the Honours grade. An indication of their nature may be found in those put at the last examinations, which were given in the "JOURNAL" for May 12 (p. 1050). But the fullest information can be obtained from the "Programme," which is published by Messrs. Whittaker and Co., of Paternoster Square, at the price of 10d. net.

The "Veritas" Gas Arc Lantern.—The largely increased adoption of the incandescent gas system for both indoor and outdoor lighting has led makers of lanterns to give special attention to the protection of the mantle from the prejudicial influences of vibration, dust, damp, rain, or sudden gusts of wind. Messrs. Falk, Stadelmann, and Co., Limited, claim that they have secured this in their "Veritas" gas arc lantern, which differs from others mainly in the adoption of a hermetically closed glass globe round the burner, and surmounted by the lamp-head, constructed with the necessary air-conducting passages or chambers. The lanterns are equally suitable for exterior or interior lighting; and they have been adopted by many of the leading gas companies. A large number have been supplied to the Hastings and St. Leonards Company for street lighting; and their satisfactory working led the Company to arrange for the lighting of the whole of the St. Helen's Road with them during the "Carnival" which commenced yesterday. The lanterns have been in use for several months on the Lees Promenade at Folkestone, where they have stood the test of heavy gales.

REGISTER OF PATENTS.

Gas-Generators for Use with Explosive Engines.—Ladd, J. H., of Queen Victoria Street, E.C. No. 14,242; July 26, 1895.

The inventor points out, in his specification, that Stringfellow's patent, No. 6575 of 1890, and his own patent No. 10,477 of 1895, describe a process for the manufacture of gas by charging atmospheric air first with hydrocarbon vapour, and then with the vapour of water. "The gas thus produced is very advantageous for use in gas or explosion engines, partly because it can be produced at comparatively low cost, and will produce far more power than coal gas, and partly because its combustion attains such a high degree of perfection that no deposit will be formed in the cylinder and other parts of the engine, which can therefore be worked without cleaning for a longer period than the ordinary gas or oil engines." He claims to have devised an improved method of working an explosion engine, consisting in drawing atmospheric air, by means of the engine-piston, first through absorbent porous material saturated with liquid hydrocarbon, then through absorbent porous material saturated with water, and then, in the form of a gas consisting of atmospheric air, hydrocarbon vapour, and vapour of water, into the engine cylinder, in which, by its explosion, after being compressed, it drives the piston outward. The invention also comprises a gas-generator adapted for use in combination with such an explosion engine.



The accompanying illustration shows, in vertical central section, a gas-generator of suitable construction to be connected with an engine.

The engine inlet and valve for the admission of gas to the cylinder, are larger than the inlet and valve usually employed in gas-engines. The inlet is connected to the delivery or outlet pipe L for the gas from the water-chamber of the gas-generator, so that, each charging stroke of the engine-piston, a charge of the gas will be drawn directly into the cylinder, and at the same time a corresponding quantity of atmospheric air will be drawn into the generator.

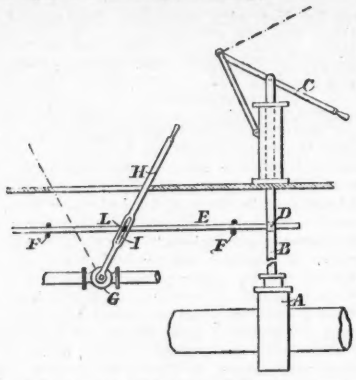
The generator consists of a metal drum or cylinder P, divided by a vertical partition into two compartments A B, one of which serves as the carburetting chamber, and the other as the water-chamber. In the former chamber (A) are arranged domes or screens E of absorbent porous material, and also similar frames or screens E^1 placed one above another. The air-inlet pipe D extends through the bottom of the cylinder into the space beneath the screens E, and has a hood or deflector arranged over it. Above the screens E^1 is formed, in the partition, a hole from which a pipe K extends downward, for the purpose of taking the carburetted air into the space beneath screens of absorbent porous material in the chamber B. The delivery or outlet pipe L, which is connected with the inlet of the gas-engine, extends from the upper end of this latter (the water) chamber. In the top of the carburetting chamber is a central pipe J, provided with several smaller distributing pipes extending radially from it, and having turned-down nozzles, or other device for distributing the oil over the screens. Above the chamber is an oil-tank C, connected at its lower end with the distributing device; a suitable valve being provided for controlling the flow of the oil through the distributor. The generator may have a jacket or casing M, or be provided with a coil of pipe, through which the exhaust gases from the engine (or any other suitable heating medium) may be conducted, so as to maintain a suitable degree of temperature in the generator. In the arrangement shown, the jacket M is connected with the exhaust of the engine.

Fittings for Water-Gas Generators.—Cutler, S., of Millwall, E. No. 17,742; Sept. 23, 1895.

The object of this invention is to render impossible the simultaneous opening of both the air and steam valves of water-gas generators, by providing an interlocking device operated by the steam-valve controlling mechanism in such manner that, when the steam-valve is open, the air-valve is locked in its closed position, and *vice versâ*.

In one arrangement, the rod for controlling the steam-valves is connected to a series of reciprocating locking bolts through screw, rack, lever, or other suitable connecting gear, so that the act of opening or closing the steam-valves causes the bolts to be correspondingly and simultaneously reciprocated forwards or backwards. The air-valves being closed, the opening of the corresponding steam-valve causes the reciprocating bolts to be simultaneously projected into slots or recesses, or otherwise to engage in the connecting parts of the air-valves, and prevent them from being moved until the steam-valves are again closed and the reciprocating rods withdrawn. The slots or recesses in the spindles or other connecting parts of the air-valves are arranged in such positions that the reciprocating rods can only be projected into them when the valves are fully closed; and as it is impossible to open the steam-valves except when the slots or recesses are opposite the reciprocating rods, the air and steam valves cannot be open at the same time.

The accompanying engraving represents, diagrammatically, an elevation of one arrangement of fittings, for a single steam and air valve.



The air-valve A is connected, by a rod B, to an operating lever C, and has formed in it a hole D through which a reciprocating rod E, working in guides F, is free to pass when the air-valve is closed. The steam-valve G is operated by a hand-lever H, provided with a slot I, in which a pin L, in the rod E, travels; so that the act of opening the steam-valve G also causes the rod E to slide in its guides and into the hole D, and thereby lock the air-valve in its closed position. The act of closing the steam-valve withdraws the bolt, and allows the air-valve to be opened. The steam-valve cannot be opened unless the position of the vertical rod B is such that the hole D in it is opposite to the reciprocating rod E—that is, when the air-valve is closed.

Self-Lighting Gas-Burners.—Kent, H. A., of Bowes Park, N. No. 18,012; Sept. 26, 1895.

This invention refers to gas-burners in which the gas is lighted by means of platinum black, or platinum in a fine state of division, or iridium, rhodium, paladium, or alloys thereof which, under the action of illuminating or heating gas and air, will become heated to such a degree that, by means of a platinum wire, it will cause the gas issuing from the burner to be ignited. Hitherto, says the inventor, considerable difficulties have arisen in the practical application of this mode of ignition; the principal difficulty being that the igniting medium, when subjected to the action of the flame of the main burner, has soon been converted into a carbide, and is then unfitted for its purpose. It has been proposed to overcome this difficulty by providing a bye-pass for the gas, to be first ignited, and then to be diverted from the bye-pass to the main supply to be ignited. But this necessitates the provision of special taps and extra pipes or passages; and it is therefore expensive, and difficult to apply to ordinary gas-fittings.

The present invention consists in first causing a small supply of gas to pass, with air, in contact with the igniting material used, and to become ignited thereby; the heat of the flame so produced being caused to act upon a device which, under the influence of the heat, is caused to open the supply of gas to the main burner, and then to effect the closing of the supply of gas to the igniter. The flame first kindled at the igniter, after igniting the gas issuing from the main burner, is therefore extinguished; and the igniting material is thus protected from the injurious effect of continued subjection to the action of a flame.

The platinum black and platinum wire are preferably enclosed in a chamber, to prevent injury or displacement of it; and the device which is acted upon by the heat of the flame of the small jet first ignited, consists of any arrangement which can be caused to alter its dimensions or position under the influence of heat sufficiently to effect the opening of the supply of gas to the main burner, and afterwards the closing of the supply of gas to the small jet first ignited.

Gas-Generators.—Thuman, F., of Victoria Street, S.W. No. 23,170; Dec. 3, 1895.

This invention relates to generators in which gas is produced by passing air or steam through a previously heated mass of carbonaceous fuel; and it has particular reference to the construction of the grates upon which the fuel mass is supported in the generator, and to the combination of the grates with the generator.

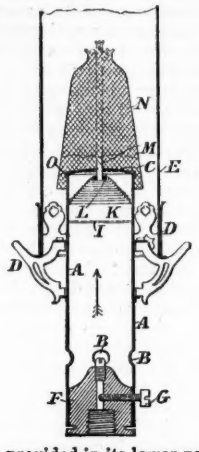
Generators of this kind have usually been provided with cleaning doors, extending through the walls above the level of the grate-surface; and the doors open both above and below the grate-surface, so as to give access at the same time to the ash chamber and to the top of the grate—access to the grate being necessary for the introduction of the cleaning tools and the extraction of the clinker and ash. Much trouble has been found to ensue, the patentee remarks, from this construction, particularly in water-gas generators, in which steam is from time to time reversed in its direction of passage through the fuel—the principal mischief being due to the tendency that exists to fuse away the fire-brick lining of the generator immediately above the cleaning-doors, caused by the unequal distribution of the air-blast and steam, and by the lodgment of fuel in the fire-door openings.

The object of the present invention is to avoid these tendencies; and this is accomplished by normally supporting the grate substantially at the level of the top of the cleaning-doors, and at the same time so constructing the grate that it can be removed in such a manner as to give passage through the cleaning-doors for the tools and clinker. It is obviously not necessary to move the entire grate for this purpose; and the patentee therefore, preferably, constructs the grate in sections, some of which, registering with the cleaning-doors, can be moved in such a way as to give the necessary opening through the doors to the top of the grate.

A further purpose of the invention is to provide means for removing all the clinker and ash from the fuel-bed, with the removal of the least possible amount of valuable fuel from the generator. With grates heretofore constructed, large quantities of fuel have been allowed to fall through the spaces of the grate-bars into the ash-chamber during the process of cleaning the fire and subsequently withdrawn with the ash. To avoid this, means are proposed of closing at will the spaces between the grate-bars of the fixed portions of the grate, by employing a secondary moveable grate or grid, so constructed that its bars can be made to close the spaces of the upper primary grate during the period of cleaning the fire, and can be retracted during the time the generator is in action.

Burner for Gas and Gaseous Combustibles.—Thompson, W. P.; a communication from the Gesellschaft für Stossfeste Glühlicht Brenner "Patent Fritz" G.M.B.H., of Berlin. No. 12,542; June 8, 1896.

This invention relates to burners for coal gas or the volatilization products of hydrocarbons, whether burnt as ordinary lighting flames or adapted to the heating of incandescence bodies. It further relates to devices to control the supply of gas and the pressure of the gas and air mixture supplied to the flame, as well as to effect the mixing of the gas and air, with the object of "obtaining a hot non-luminous flame." The method of carrying the invention into effect is by the arrangement of a piece inserted in the lower part of the gas-supply pipe in the form of a slit-burner at the place where the air openings are, or by means of a cap regulated automatically by the pressure of the gas. The mixture of the gas with the air is effected by a sieve or wire-gauze insertion, as well as of a spiral insertion of wire or metal strips in the upper part of the burner. This spiral insertion may be either rigid, or in the form of a spiral spring, in order to serve at the same time as an elastic support for the incandescence body, so as to render harmless the vibrations and shocks received by the burner.



A is the burner-tube, provided in its lower part with holes B for the entrance of the air, and at its upper end with a perforated loosely fitting sheet-iron cap or a wire-gauze cover C. Upon A is fitted a gallery D, for the glass E. At the lower end of the tube, there is an inserted piece F completely filling the tube, with a bored-out piece furnished with a screw-thread, which serves to permit of the burner being screwed upon a lamp. This inserted piece has in the middle a bore-hole into which is inserted a slit burner, through which the gas passes into A in the form of a large flat stream, and causes an energetic in-draught of air through the hole B, and prevents any striking-back of the flame. The flow of gas is regulated by the set-screw G according to the varying gas pressure.

In the upper part of the burner-tube is arranged a perforated dividing wall or a wire gauze I, which has for its object to cause an equal division of the mixture of gas and air. A spiral insertion K, formed of spirally wound wire or metal strip, is fixed over I and under the perforated cap C for the same object. This insertion is attached by its outer coil to A, and bears in a central plate L the supporting bar M for the incandescence body N. In order to prevent the mantle being injured through contact with the upper end of the tube A, which becomes very hot, the latter is preferably provided with a ring O of asbestos, soap stone, or other suitable material. The spiral insertion K may either be rigid or preferably be formed of elastic material, in order to serve as a support for the incandescence body, and with its support M connected with the loose cap C.

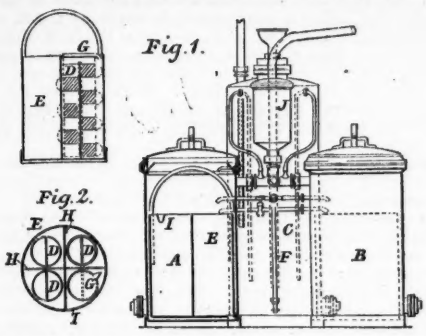
Producing Acetylene Gas.—Deroy, H. A., of Paris. No. 12,683; June 9, 1896.

The patentee proposes to treat calcium carbide in a manner similar to that employed in diffusion, exhausting, and extracting apparatus used for obtaining saccharine matters from sugar cane and beetroot, and in the manufacture of colouring, pharmaceutical, and other extracts.

Fig. 1 shows the apparatus employed, composed of two vessels AB, with the necessary arrangement of cocks and pipes and other supplementary parts.

The carbide is spread in perforated baskets in thin layers, separated from one another by a layer of inert substance—such as gravel, slag, or the like. A partition divides the basket vertically into two portions, so that the separated layers are acted upon immediately after one another. For the sake of clearness, the layers of carbide and inert material are shown as plain and hatch-lined squares in the section of the basket, fig. 2. The vertical dotted lines represent the separating partition; and the curved dotted lines indicate the order of the successive actions. This system of charging, it is claimed, has the advantage of regulating the production of the gas, by operating on small quantities of carbide, and preventing the swelling of it in the basket, the contents of which are maintained at about the same level until completely spent.

The baskets D are placed in the compartments of removable buckets E, which form a double casing, and isolate the baskets from the condensation yielded by the gas, and which, by accumulating in



the vessel, would attack several baskets at a time. The covers of the vessels are provided with gutters, which collect the condensation. The water enters through the tube F, in the direction of the vessel at work, and drops on to an overfall G, which directs it to the bottom of the basket of the compartment in which the action upon the carbide is commenced. When the carbide in the first basket is spent, the compartment is filled with water, which overflows through a small aperture H, and enters the bottom of the following compartment; and so on, from compartment to compartment (in any required number), until the water, having run through the whole of the buckets, reaches the other vessel. The acetylene, in becoming disengaged, draws aqueous vapours along with it; and if the condensation resulting therefrom fills the space between two receptacles, this condensation is drawn off through an aperture I in the outer wall of the bucket at the side of the compartment first acted upon. Into this compartment also passes the condensation formed beneath the cover.

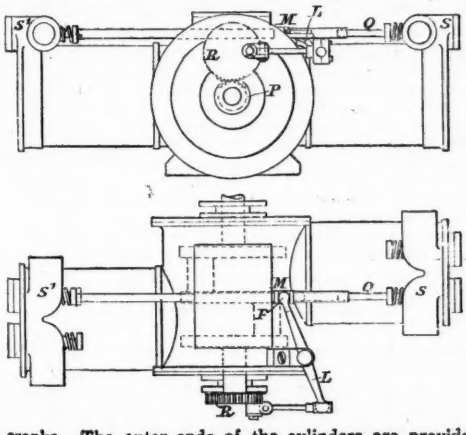
After having charged the vessels, a cock between them and the purifier J must first be opened; and the cock for opening communication between the vessels; then the water-inlet cock to the vessel A. The water coming from the reservoir C through the tube F ceases to enter under a certain pressure, and is only caused to again enter when the pressure is slightly lowered; so that the carbide becomes automatically moistened just sufficiently to supply the consumption of the gas. When all the carbide in the vessel A is exhausted, the water passes to the vessel B, which then comes into action. The former vessel can then be recharged.

The purifier J (filled with wood fibre, coke, or other suitable material) serves for drying the gas, which always carries aqueous vapours along with it. The condensation passes back into the vessels, and is conducted towards the reservoir or else ejected through a syphon tube.

Motive Power Engines Driven by Gas.—Crouan, H. M. L., of Paris. No. 12,758; June 10, 1896.

The accompanying illustration is a front view and a plan of the invention.

Two main cylinders are fixed opposite to one another upon a central drum, through the ends of which the crank-shaft passes, having two cranks adjoining, but opposite to each other. They are not, however, in the same line in plan; each being directed towards one



of the cranks. The outer ends of the cylinders are provided with inlet-valves, and also with exhaust or outlet valves; the latter being arranged exactly opposite to one another, so that the valve-spindles are in the same line.

These valves are operated as follows: Upon the crank-shaft is fixed a pinion P, driving a wheel R of twice the diameter. The latter is provided with a crank-pin, actuating a connecting-rod; the end adjoining the crank-pin being jointed so that the connecting-rod can bend at right angles to the wheel. The other end of the rod has a universal joint, fitting upon the outer end of a horizontal lever L, which drives by its other forked end F a cross-head M, having at each end a steel tube which slides freely upon the rod Q connecting the two opposite exhaust-valves. It opens each of the valves alternately, at the ends of its stroke, by coming in contact with nuts which retain springs by which the valves are closed.

The wheel R in revolving causes the lever L to oscillate, and a short distance before reaching the end of its stroke (to the right for example) strike, by means of a tube which it carries, the nut of the valve S, and opens the latter. On the return stroke, this valve first closes; and the stroke continues without any further action until the end of the tube on the left strikes in its turn (a little before reaching the end of its stroke to the left) against the nut which retains the spring of the valve S, and opens it. Alternate opening of the two valves is thus effected at each revolution of the wheel R. The valve for the admission of the gas and air mixture is automatic; the mixture being drawn in by the movement of the pistons.

Mantles for Incandescent Gas-Lights.—Voelker, W. L., of Elizabeth, New Jersey, U.S.A. No. 13,255; June 16, 1896.

This invention "aims to provide a process by which hoods or mantles that are formed of suitable incandescible materials may be baked in a manner to procure uniform results with respect to shrinkage and tenacity of the hoods and the form of the same."

The process depends upon a discovery which the patentee claims to have made—that if a hood or mantle, after being dried sufficiently to stand without collapsing, is plunged into an atmosphere which is heated to a very high temperature (as, say, from 3500° to 4000° Fahr.), it will be baked without perceptible distortion of its form, and with uniform tenacity and strength in all parts. The temperature should be higher than that to which the mantle will be subjected when in use.

The process in detail is as follows: Hoods, to the number of 25 or 30, having been first sufficiently dried, and of the usual shape, are suspended on the tops of the fire-clay rods, if the materials of which the hoods are composed shrink much in baking. When, however, the materials do not shrink perceptibly in baking, the hoods may be supported at their bottoms on slabs of nickel. The rods (if used) are placed upright in holes bored in flat fire-clay slabs which, with their rods and hoods, are then placed in the oven of a gas-furnace that will generate the intense heat necessary—about 3500° to 4000° Fahr. When the first batch of mantles is to be baked, after the oven is first heated up, the door is opened for a short time—say, half a minute. In this time, the great pressure in the oven momentarily vents itself, before the mantles are brought near, so that danger of shattering the mantles is obviated. The shape and size of the oven should be such that it will just hold one slab of hoods with the least possible vacant space. "The heated atmosphere then comes on the hoods with a pressure that resembles in its effects the pressure of an enveloping mould or die," and insures "uniformity of strength and tenacity throughout the material of the hood."

Mantles for Incandescent Gas-Lights.—Voelker, W. L., of Elizabeth, New Jersey, U.S.A. No. 13,256; June 16, 1896.

This invention relates to the filaments of which hoods or mantles for incandescent gas-lights are constructed; and it is the aim of the invention "to produce a filament having such tensile strength that it can be readily handled by ordinary weaving or braiding machinery." The incandescing material of which the core of the filament is composed may be made in any known manner—as, for example, by combining any incandescing oxides of the rarer metals, or oxides of magnesium and calcium with a viscous material. The subject of this application is, however, not the incandescing core *per se*, but "the reinforcing or protecting of any incandescing filamentary core by a suitable envelope of fibrous combustible material."

The patentee proceeds in the following manner: When the thread or fibre of incandescible material is sufficiently dry, it is covered with a thin cotton braid, or (as some wires used in electrical work are) by right and left hand spiral winding; or several strands of cotton yarn, or other combustible fibres, may be run along the thread or filament of the incandescible materials, and then the cotton cover run on spirally. The mechanical strain produced by the braiding or weaving machinery is taken up by the cotton covering placed on the filament in the manner described; and the mantle will thus, when baked, have loose contact joints; while the fibrous covering does not interfere with the contraction during baking, but preserves the elasticity of the thread a long time.

An important result of covering the filaments with the case or sheath of combustible material is claimed to be that the filaments do not stick together at the points where they cross or interlace, but remain free. Therefore, when the covering is burned out, a hood remains composed "of filaments each of which is free to expand and contract without exerting strain on the other filaments or being strained by them; and the durability of the hood is, in this manner, materially increased."

APPLICATIONS FOR LETTERS PATENT.

17,624.—Poetsch, G. F. H. W. and F. H., "Draining rocky beds, water-bearing strata, and the like, and damming water generally." Aug. 10.

17,644.—Goodwin, R., "A gas plant and system to make and produce acetylene gas, or acetylene and carbonic acid gas combined." Aug. 10.

17,646.—Duffield, M., "Acetylene gas generator." Aug. 10.

17,678.—Fraser, A. C., "Generating and liquefying acetylene." Aug. 10.

17,714.—Légé, A. J. B., and Pennellier, A. D., "Production and burning of acetylene gas." Aug. 11.

17,729.—Knapp, I. N., "Treatment of illuminating gas." Aug. 11.

17,792.—Harrison, C. G., and Howard, H., "Fittings for metal pipes." Aug. 11.

17,813.—Raphael, M., "Automatic protector for incandescent gas-light mantles." Aug. 11.

17,888.—Oldenbourg, E., "Gas or vapour burners." A communication from L. Runge. Aug. 12.

17,904.—Lake, H. H., "Generating and utilizing acetylene gas for lighting purposes." A communication from O. Grenier and J. Grand. Aug. 12.

17,938.—Lyon, C. W., and Deighton, G., "Filling scoops for charging retorts in gas-works." Aug. 13.

17,958.—Boardman, F. R., "Burners for use in gas lighting." Aug. 13.

17,977.—Luechau, W., and Gisbert, F. J. de, "Gas-generating burners for boiling and heating purposes." Aug. 13.

CORRESPONDENCE.

[We are not responsible for the opinions expressed by correspondents.]

Mr. Damon and the Evans Photometer.

SIR,—I have been very seriously ill, or I should have replied to Mr. A. Ferris Damon's letter, with reference to the Evans photometer, which has appeared in the "JOURNAL." I had read Mr. Damon's evidence given by him before the House of Lords Committee, and the subsequent correspondence between him and Mr. W. Sugg, with reference to the "abnormal results" said to have been found by Mr. Damon in the dispute between the Corporation of Dublin and the Gas Company. The gist of the argument appears to be as to the *reliability* of the Evans photometer. The consideration of this nice and puzzling question in the science of ethics has given rise to a particular department distinguished by the title of "casuistry."

As I worked with the Evans photometer for more than 30 years, it will not be out of place if I make a few observations. The first Gas Referees were Mr. F. J. Evans, Major Pierce, and Mr. R. Hogarth Patterson. It is safe to say that neither of the last two gentlemen knew anything about gas or gas testing. One was a "Major of Volunteers," and the other a "Journalist." Mr. F. J. Evans was invited by the Board of Trade to arrange as to the testing of the London gas. Thus "invited" he arranged for the construction of the first testing-station at No. 17, Arundell Street, Haymarket; and here was erected the first official Evans photometer. Afterwards the same instruments were put up at No. 16, Millbank Street, Westminster, Hill Street, Peckham, Carlyle Square, Chelsea, Stoney Lane, Tooley Street, and at other places.

I worked daily with the "Evans," at all these places for very many years; and during the whole period I did not find those "abnormal" results which Mr. Damon found. I will leave out the question of "tinkering" to which Mr. Sugg refers; only remarking that I did no "tinkering," but simply used the instrument as it was certified by the Referees.

I must here digress. The first photometer Mr. Damon ever saw (an "Evans") was shown to him by me at Carlyle Square, Chelsea; and it was on this instrument that Mr. Damon obtained his knowledge of photometry that enabled him to obtain the appointment of Gas Examiner at Notting Hill.

It seems that some of Mr. Damon's "abnormal" results were obtained both before and after the judicious "tinkering" to which Mr. Sugg alludes. But is "tinkering" allowable or legal? Should not the photometer be used as "certified" by the Referees. I remember very well that the late Mr. T. W. Keates instructed me that everything in the station must be used as "certified." I also know that this wholesome rule has been departed from by the present Superintending Gas Examiner, and very much so by Mr. Damon.

In my opinion, the Evans photometer, fairly used, is about the best form for testing gas, and will give results as near the truth as we can hope to get them; and this will be very evident if the instrument is carefully examined.

I had occasion some years ago to make an examination and measurement of an Evans photometer with the late Professor Foster, of the Middlesex Hospital; and I would very seriously advise Mr. Damon to read Professor Foster's paper, which will, I think, have the effect of changing his opinions.

Mr. Damon in his letter states: "It is a well-known fact that the adoption of the Evans photometer was due to the fact that Mr. F. J. Evans required a photometer for testing the illuminating power of gas in the open air; and this instrument was subsequently introduced into various testing-stations." What the "open air" testing had to do with the "testing-stations," I do not know. I will, however, tell Mr. Damon that this is not a "well-known fact"—nor is it a "fact" at all. I had the "facts" from Mr. Evans himself. The object Mr. Evans had in his invention was to correct the ventilation in the testing-stations; and to a great extent he succeeded.

It may be as well to remark that Mr. Evans was much too astute to attempt the testing of gas "in the open air," with his own, or any other photometer.

J. VINCENT TAYLOR, F.C.S.,
For Twenty Years Gas Examiner to the Metropolitan Board of Works and the London County Council.

Aug. 14, 1896.

LEGAL INTELLIGENCE.

THAMES POLICE COURT.—Thursday, Aug. 20.

(*Before Mr.* CLUER.)

Consumers Fined for Wasting Water.

To-day, *Peter Ringen* and *Betsy Ringen*, his wife, of 177, Jubilee Street, Stepney, appeared to answer several summonses, taken out at the instance of the East London Water Company, for wilfully causing the water-fittings to be so used that the supply was wasted, and for causing the draw-tap to remain open.

Mr. G. KEBBELL, who appeared for the Company, said he proposed to proceed with two of the summonses against Mrs. Ringen, taken out under section 32 of the Metropolis Water Act, 1871. The facts he should adduce would convince the Court that there had been an appalling waste of water; and it was one of the worst cases that had ever come before a Magistrate. The defendant had wasted water for years. Two years ago, it was discovered that she had a duck-pond, filled with water by means of a pipe from the sink. Such wilful waste of water was a source of danger to the community. She had wasted at least 2000 gallons a day.

Robert Kettle said he was clerk to Mr. Fordham, builder, whose premises were next door to defendant's house. There was a workshop, which overlooked defendant's yard. Last October, some of the workmen made a communication to him, and he looked into the yard, where the water was running from the tap full on. From time to time after that he saw the tap, which was always open full bore. At last he wrote to the Company; and on Monday, July 27, at about six o'clock in the morning, he made a communication to one of the officials, who also looked at the tap, which was full on, and the water was running away. There was a waste-pipe at the back of defendant's house, and it came from a pipe over the sink. He saw water flowing from the waste-pipe at the same time that the yard tap was open.

By Mr. DEAKIN (for the defendant): When he saw the waste in October he did not tell anyone, as he did not know that it was not accidental. In June he wrote to the Company as he thought it necessary to do so.

Other witnesses having deposed to seeing water running to waste,

Walter Sellwood, waste inspector, in the employ of the Company, said that on June 17 he went to defendant's house and saw her. His foreman, Green, told her the Company had received a letter, and he had come to see if there was any waste of water. Defendant was also told that the water would be cut off if she continued to waste it. On the 18th witness went again to the house; but defendant, whom he saw inside, would not open the door. He then dropped a notice in the letter-box. On the morning of the 27th, he saw the water running from the tap at full bore, and to waste. Some hours after, he again found the tap running full-bore. It was a screw-down ½-inch tap, and could not be accidentally turned. During the five hours the water was on, 1200 gallons would be wasted. The waste was discontinued after the summonses were taken out. During the drought, there had been a standpipe on the main, and defendant could get plenty of water from it, as the main was always charged.

George Green, one of the Company's foremen, stated that the district received a constant supply.

Mr. *Hebeler*, the General Superintendent of the Company, said with a ½-inch pipe and the pressure that was on on the days mentioned, the flow would be 240 gallons an hour. It was found necessary to shut down the mains about the 13th of July; and it was waste such as this that had brought about the present position.

Mr. CLUER: We are not here to justify the Company.

After a legal argument,

Mr. CLUER said he failed to see that defendant was liable under the present summonses; but before deciding he would hear the others.

The case against Mr. Ringen was then gone into.

Mr. DEAKIN submitted that he had no charge to answer, for there was no evidence to prove that Mr. Ringen had been guilty of either negligence or wilfulness. Under these circumstances, the summonses must fail.

Mr. CLUER was satisfied that defendant must have known of the waste, and said it was impossible to overlook the fact that it had not been going on for a short time. On the other hand, it would have been reasonable if the Company had written to the defendant. He would be fined £3, and £2 2s. costs.

Mr. KEBBELL then proceeded with other summonses against Mrs. Ringen, under the Water-Works Clauses Act.

The facts having been proved,

Mr. DEAKIN, on the authority of "Stone," contended that the water was private property, and that consequently the lady was not liable for the waste.

Mr. CLUER ruled otherwise, and said the Company were quite right in bringing the case before the Court. She would be fined the full penalty of £5.

The first summonses were dismissed.

The Supply of Gas through Prepayment Meters.

At the Westminster Police Court, on the 15th inst., George Rayson, of Jubilee Place, Chelsea, was summoned by The Gaslight and Coke Company for 5s. 5d., an amount due for gas supplied. Defendant took over, with his premises, an automatic gas-meter. At first, in February, the pennies exceeded the quantity of gas supplied; then, in March, the gas exceeded the pennies. Thereupon the Company changed the meter; but the second one was not satisfactory, and the defendant refused to allow it to be changed again. From the cross-examination, it appeared that the machine did not yield up to the collectors all the pennies it contained. Mr. De Rutzen said he had some sympathy with the defendant; but the terms of the contract were that he agreed to pay for the quantity of gas his meter registered. If he entered into a contract, he should be the last person to find fault with it. There would be an order for the sum claimed, with 24s. costs.

Selling "Incandescent Nipples."

At the Colchester Police Court last Friday, John Fagan, a commission agent, of Bedford, was charged with having unlawfully obtained from Mr. William Paxman, of North Hill, Colchester, the sum of 24s. Mr. Paxman said the prisoner called on him on the previous Monday, and, after some conversation on gas-burners, produced a bunsen burner and fixed it to a gas-bracket. He next brought out several small gas-nipples, and, after putting one on a bracket, lit the gas—asserting that, with the use of this nipple, there would be no smoke or fumes. In consequence of these statements, prosecutor bought twelve nipples at 2s. each. After the accused had gone, prosecutor found he could get the same results from ordinary gas-burners, and that the nipples which had been represented as having incandescent bottoms to consume the fumes, were only worth 3d. or 4d. each. Prosecutor admitted, however, that the nipples were much superior to his own. Mr. H. S. Pike, the Manager of the Colchester Gas-Works, said he had examined the nipples, and had found that they were only the ordinary kind, worth at the very outside 6d. each. The only difference was that there was a small slit instead of a round hole in the bottom of the burners. This was no more effective than a hole; and there was nothing in the burners to prevent "smoke or fumes," as had been stated. The accused pleaded guilty; and the charge having been altered to one of larceny by trick, in order that the Magistrates might deal with the case summarily, a fine of 40s. was imposed.

MISCELLANEOUS NEWS.

LIVERPOOL UNITED GAS COMPANY.

The Half-Yearly General Meeting of this Company was held last Tuesday—Mr. E. LAWRENCE in the chair.

The Directors, in their report for the year ending June 30, stated that the total revenue during this period was £531,380, and the expenditure £413,478, leaving a surplus of £117,902, which had been transferred to the credit of profit and loss. After deducting the amount taken for the payment of the dividend declared in February, and the interest on the bond and debenture debt, there remained a balance of £53,190, out of which they recommended the payment of a dividend for the past half year of 5 per cent. on the ordinary consolidated stock, and 3½ per cent. on the 7 per cent. stock. The prospects of the Company for the current year justified, in the opinion of the Directors, a further reduction in the price of gas to 2s. 9d. per 1000 cubic feet; and they accordingly announced this reduction, to take effect from the end of last quarter.

The CHAIRMAN, in moving the adoption of the report, said he was sure the accounts for the year would present themselves to all the shareholders in a favourable light. Although he had always been disposed to take a somewhat sanguine view of affairs, he hardly expected that the figures would have come out so satisfactorily as they had done. As regarded expenditure, the main item was a reduction in the price of carbonizing material, on which there had been a saving of £29,495. This, of course, arose mainly from the decrease in the price of coal, which had cost them slightly less than 14s. 9d. per ton, as against 16s. 9d. in the previous year. On the other side of the accounts, the amount realized by the sale of gas, including street lighting, was £27,814 less than in the previous twelve months; this arising from the reduction in the price of gas from 3s. to 2s. 10d. per 1000 cubic feet. With regard to residual products, the result was rather startling. They lost on coke £9012 compared with last year, though they had sold 3000 tons more. The fact was that the price of coke had been about 6s. 8d. per ton, against 7s. 11d. in the preceding year. Then on ammoniacal liquor there was a deficiency in the sales amounting to £13,803. This was accounted for by the fact that they received for ammoniacal liquor 45s. 1d. per 1000 gallons, against 74s. 9d. in the year 1894-5—a reduction of nearly 50 per cent. in the market price. In spite of all this, the balance at the close of the year was £117,901; and after payment of the debenture interest and statutory dividends, there was a surplus of £1406. In looking forward to the coming year, the Directors had made a very careful estimate of income and expenditure, and found that, allowing for everything that might arise, and making a fair calculation of all charges likely to come upon them, they might with safety reduce the price of gas another penny per 1000 cubic feet. He hoped their friends the public would consider this satisfactory, though he knew they were taught never to expect that anything the Company did for them would meet with unmixed approval. However, the Directors felt it was their duty to make the reduction; and he thought the shareholders would feel that in this they were doing what was right in the interests both of the public and of the shareholders—interests which were never forgotten by the Directors. The working of the Company had gone on very satisfactorily. They could congratulate their officials on the way in which their duties had been performed; and he did not think that the plant and works had ever been in a better position than they were now. Alluding to the relations between the Company and the Corporation, he said he was not in a position to communicate much at present. The Lighting Committee of the City Council had presented a report to the Corporation, and had forwarded to the Directors a copy, with a request for their opinions upon it. Steps had been taken to have the matter thoroughly investigated; and at the earliest possible moment a suitable reply would be sent to the Corporation, which he hoped would satisfy them as far as the Company were concerned. He thought, however, he was entitled to say that the report of the Corporation, which was a document open to the public, was a complete vindication of the Company from all charges that had been made against them during the past few years. If they had attempted it themselves, they could not have done it better than the Corporation had done; and therefore it now stood upon the Corporation records that the Company had not been false to the duties entrusted to them, and that these duties had been discharged faithfully. The policy, practice, and administration of the Company was acknowledged by the Corporation to be what could be expected of it. Of course, this would not satisfy some people who had made up their minds that they were an iniquitous body of men, and who would stick to their opinion whatever anybody might say to the contrary. Still, if any fault were found with them now, they could appeal to this record, made by those who were disposed to carp at what they had done. He noticed that Alderman F. Smith (who, of course, had his own feelings towards the Company, and he supposed always would have) stated in the Council a few days previously that he could tell Alderman Forwood where the Company obtained their materials from—that they bought their coal from a firm of coal dealers in London. This statement, like a great many others made by Alderman Smith, was the result of his own fervid imagination, which seemed to be able to conceive anything he desired. He hoped, however, the public would understand what was stated in the Corporation's own report, that the Company bought their coal, after tenders were received, from anyone throughout the whole of the United Kingdom who liked to offer material to them, and that what was purchased was the cheapest and best for the work they had to do. No one could do it differently, and no one could do it better. Now that the Corporation had expressed themselves definitely and decidedly on this point, he hoped that they would hear no more of these charges, almost amounting to malfeasance in the administration of the affairs of the Company. There had also been a sneer that they went to the ends of the earth to purchase enriching materials, while better and cheaper materials could be had near home. It would interest the shareholders to know that at the present moment 100 tons of mixture if they used Australian shale as an enricher were better value in the manufacture of gas than 100 tons of mixture of Wigan coal and cannel. This was his reply to those who sneered at the idea of the Directors purchasing Australian shale. To them, as shareholders, he might say that Australian shale had been one of the most useful importations of gas-producing material that the Company had ever known. He was very sorry to see that Sir Arthur Forwood had retired from the chairmanship of the Lighting Committee of the Corporation. He regretted it, because Sir Arthur entered upon his duties in that position in a thoroughly impartial spirit, and with a desire to know the actual bearing of the whole case. He (the Chairman) only hoped that the new Chairman would discharge his duties in the same high-minded and impartial way. He did not feel quite so hopeful, however, because when a gentleman rose in the Council, as he did the other day, and blamed the Company for charging more for their coke than any other company, one could not help feeling that he did not grasp the real merits of the situation. Personally, he considered that what the new Chairman of the Lighting Committee blamed them for was the greatest compliment that could be paid to them. Coke was one of their important residuals; and their object was to get the highest price for their coke. If they sold it below the market price, they simply made the consumers of gas pay the difference. The more they obtained for their residuals, the lower was the price at which they could sell gas. If it had not been for the decline in the price of coke and sulphate of ammonia, they might have reduced the price of gas in the coming year 2d. more than they were now doing. When a gentleman brought against them as a fault what really should redound to their credit, it made him feel that they had not a man who thoroughly grasped all the "ins and outs" of the case—what the manufacture of gas required, and what the duties of the Company were as regarded their position to the public. The proprietors were aware that the Corporation had become possessors of the electric lighting undertaking; and thus they were brought for the first time in their history face to face with the Corporation as producers of a rival illuminant. They had nothing to complain of in this; it was one of the chances of war. All he had to say was that he hoped they would be enabled so to conduct their affairs as to show that, in the face of this competition, they would be able to maintain in the future the position they had so long occupied in the past.

Mr. H. B. GILMOUR seconded the motion.

Mr. G. H. BALL suggested that a great deal of the criticism of the Company's affairs might be spared if the Directors supplied fuller information in regard to such matters as contracts and the price of coal.

The CHAIRMAN, in reply, said there was no mystery at all in regard to these matters; but he did not think it necessary to make public their contracts, or state from whom they purchased their coal. The report of Mr. Charles Hunt, the Gas Engineer of Birmingham, who was called in by the Lighting Committee of the Corporation, and who stated that, in regard to the purchase of carbonizing materials, "the selection is well and carefully made," was a complete answer to all the charges that had been brought. They had no secrets; but there were several things they could not be expected to publish, and this was one of them.

The report was adopted.

On the motion of the CHAIRMAN, seconded by Mr. GILMOUR, a dividend was declared for the half year of 5 per cent. on the ordinary consolidated stock and 3½ per cent. on the 7 per cent. stock.

The retiring Directors and Auditor were then re-elected; and the proceedings closed with the usual vote of thanks to the Chairman.

CRYSTAL PALACE DISTRICT GAS COMPANY.

The Ordinary Half-Yearly General Meeting of this Company was held at the Albion Tavern, Aldersgate Street, E.C., on Friday last—Mr. GEORGE LIVESEY in the chair.

The SECRETARY (Mr. Charles M. Ohren) read the notice convening the meeting; and the report, with the accounts for the six months to June 30, epitomized in the "JOURNAL" last week, was presented.

The CHAIRMAN moved—"That the report of the Directors and the accounts be received and adopted, and the report entered upon the minutes." He said the report gave a fair statement of the condition of the Company during the half year; opening with the announcement that, while there had been a reduction of expenditure of £4724, there was, on the other side, a reduction of income of £6964, which landed them in a deficiency as to dividend. He first dealt with the question of how this deficiency was met. The statement was made that they were about £2400 short—really £2470 short on the revenue account. But, on reference to the net revenue account, it would be found that they had carried the interest on the reserve fund (£530) to net revenue, which reduced the deficiency to £1946 17s. 8d. This was about equal to 1d. per 1000 cubic feet of gas sold, which meant that if they had received another 1d. per 1000 cubic feet, they would have just paid their way. This method of appropriating the interest on the reserve fund being new, he (the Chairman) thought it required a word or two of explanation. Under the old system gas companies were limited as to the amount of their reserve fund. When they had paid full dividends, and accumulated a reserve equal to 10 per cent. on the capital, they were not allowed to further increase it in any way, but must appropriate any additional profits towards a reduction in price. If 10 per cent. on the capital was considered sufficient in the old days (and it always was ample), the Directors saw no reason why they should aim at anything higher now the Company were under the sliding-scale. By this system, they were not allowed to take anything from profits (in excess of the dividend) to the reserve fund; but if they wished to add to the reserve fund, they had to build it up out of divisible profits and interest as they had done to some extent since they came under the sliding-scale. Instead of paying the odd fraction of 2s. 6d. per cent., it would be remembered that they had added it to the reserve. The reserve fund now amounted to £40,521, which was really £500 more than they would have been entitled to hold under the old system. The maximum reserve fund to which they were then entitled was £40,000; and as they had not increased their ordinary capital since they obtained their last Act of Parliament, they

had a slight excess of reserve. The Directors, therefore, felt it right, seeing that they were a little short in the amount of profit, to carry the interest on the reserve fund to the net revenue account; and they purposed doing so in the future. As the ordinary capital increased, however, they would feel that it was right that the reserve fund should be increased in proportion. As to the deficiency, he thought the position might be all summed up in one item. Comparing the accounts of June, 1895, with June, 1896, it would be seen that, whereas in the first half year of 1895 they received £13,471 for coke, they only received last half year £10,070. That was £3400 loss on coke; and it was a very serious matter indeed. Coke had never been at so low a price as it was at the present moment. It was very disappointing, when they had hoped to have paid their way, to find that on this one item there was so serious a loss. Of course, one reason for it was that the production of coke was in excess of the demand; and this necessitated a fall in price. One reason why the demand for solid fuel was diminishing was that the Company were themselves encouraging the use of gas for cooking as much as they could; and they had also given facilities to the small householders to have their houses fitted up with gas, which had thus displaced coal and coke to a considerable extent. The gas companies were not the only ones who had discovered this fact. The chairmen of railway companies in their speeches recently had said this practice had reduced the returns from the carriage of coal on their respective railways. There was, however, another reason. Coke ought not to have gone down to the price at which it was now being sold. It was very disappointing, and very vexatious, to feel that, through the blundering of those who had the management of the business of The Gaslight and Coke Company, coke had been reduced to this very low figure. There was a loss of at least £1200 to the Crystal Palace Gas Company in the last half year through the blundering of The Gaslight and Coke Company. The latter Company could have sold coke to their contractors at 10s. a ton last September or October, and they refused 9s. 9d. in January—accumulating a stock all the time, and ultimately they had to take 9s. in March, and were now selling a good deal at about 8s. In the meantime while they were accumulating a stock of 200,000 tons of coke—an unheard-of quantity—the London buyers of coke, the cement makers and others, were importing coke into London from the Provinces; so that while coke had been accumulating in London by the Chartered Gas people, it was being brought from Birmingham, Cardiff, Bristol, Plymouth, and other places, thus increasing the difficulty here. One did not like to say these things, but he (Mr. Livesey) really felt it necessary that somebody should state the facts and the truth, which was that many gas companies were suffering from the blundering of people at Horseferry Road. The satisfactory part of their own report was the increase in business. Though there was an actual decrease of supply on the half year, still, taking the two years, they had an increase at the rate of 6 per cent. per annum. Moreover the development of the automatic or coin meters in use in the Company's district was a great source of increased business. They had 4199 in use on the 30th of June, and had laid on 1053 in the past half year, which was a large increase. They had been getting increases all the summer —it was 10¼ per cent. in the last fortnight, and it had risen as high as 14 per cent. The shareholders might take this as satisfactory evidence of the stability of the Company. Previous to the introduction of these automatic meters, their increase had rather fallen off. Instead of getting a large increase, as in the old days, they had had to be content with 2 or 3 per cent. Now it had taken a turn. It might be interesting to explain how the Company dealt with these automatic supplies. The meters and stoves were charged to capital; but the fitting up of houses was an item that was being gradually repaid. In the balance-sheet they would find "Balance due for prepayment meter fittings, £4414." It had risen from £3680 at the beginning of the half year. But they had expended since then something like £1500 in fitting up houses; and part of this was charged in this item, to be repaid month by month by consumers. Another part was charged to revenue as "fittings," £526. This left nearly £1000 to be added to the £3680 brought forward, but the total was only £4414. So that the difference had been repaid in the half year. It was perfectly correct to call it a balance, because it was not the total amount expended on these fittings —it was only a balance of the amount. The total amount expended was nearly £6000; part had been repaid—leaving the £4414 to be gradually liquidated. The Directors proposed the same dividend as last half year, which would leave a balance of £1633 to carry forward. They would have the interest on the reserve fund, which would bring it up to nearly £2200; and the Board thought that, while there would probably be a deficiency in the present half year, the amount of undivided profit would be quite sufficient to meet it, and to enable them to continue the present low price of gas.

Dr. FREDERIC HETLEY seconded the motion.

Mr. E. T. E. BESLEY, Q.C., said he had always very great pleasure in listening to the exposition of the Company's affairs by the Chairman; and the figures being so satisfactory, doubtless the shareholders thought they need tno trouble themselves to attend the present meeting. The Chairman was rather apologetic when he stated that the Company had taken the interest from the reserve fund for the purpose of revenue; but this he (Mr. Besley) thought was not an unusual thing to do. If an individual saved £100 in one year, it was very odd if he could not take £5 interest the next year as part of his revenue. If so, there could be nothing wrong in their taking the interest on the reserve fund, unless, of course, the fund was inadequate. He quite agreed that £40,000 was an ample reserve. With regard to the question of another Company refusing to sell their coke, so that manufacturers were driven to buy in the Provinces, he did not feel at liberty to discuss this question; but he would throw out the suggestion that probably the Company might, by adopting the water-gas system, burn a considerable quantity of their own coke, and thereby prevent the fluctuation in price. He thought the shareholders were to be congratulated upon getting the sliding-scale.

The CHAIRMAN remarked that the Directors considered the present reserve fund ample for all purposes.

The motion was then put, and carried unanimously.

Mr. F. L. LINGING moved—"That a dividend for the half year ended June 30 last be now declared at the following rates per annum—viz., 5 per cent. on the preference stock, and 5¾ per cent. on the ordinary stock, less income-tax."

Mr. J. GLAISHER, F.R.S., seconded the motion; and it was carried unanimously.

Mr. BESLEY then proposed a hearty vote of thanks to the Chairman and Directors for their services during the past year.

Mr. T. GUYATT seconded the motion; and it was agreed to.

The CHAIRMAN said he was much obliged to the proprietors for the vote. He could assure them that the Directors took it as a sincere expression of approval of what they were endeavouring to do in the interests of the Company. It was an incentive to them to endeavour to merit the approval of the shareholders. He could not sit down, however, without moving a vote of thanks to those who had a far larger share and greater influence in the prosperity of the concern than the Directors—namely, the officers. In Mr. Gandon they had an efficient Manager, and in Mr. Ohren an excellent Secretary; but under these two gentlemen there were a number of capable subordinates, who were interested in the affairs of the Company. The Directors desired that all their employees, from the highest to the lowest, should take an interest in the undertaking, and endeavour to promote its prosperity; and as he was sure they were doing this, he thought a vote of thanks should be passed to them. He had much pleasure in proposing it.

Mr. LINGING seconded the motion, which was unanimously carried.

Mr. C. GANDON was much obliged to the Chairman for the kind way in which he had mentioned the endeavours of the staff to promote the welfare of the Company, and for the flattering way in which their services had been spoken of in that direction. He could take to himself the credit of doing the best he could, though that this was the best that could be done he did not wish to say for a minute. He had occupied his position for twenty years, and it had always been his ambition to do the very best he could for the Company. He was glad to see that to a certain extent the effort had been successful. The Chairman had referred not only to the Secretary and himself, but to those who occupied subordinate positions; and he could assure the shareholders that, so far as his department was concerned, he had a number of energetic and enthusiastic officers associated with him who had the interest of the Company at heart.

The SECRETARY also wished to thank the Chairman for the kind way in which he had spoken of him and the officers under him. He could assure the proprietors that these officers did try their very utmost to deserve this vote of thanks.

The proceedings then terminated.

CROYDON COMMERCIAL GAS COMPANY.

The Ordinary Half-Yearly Meeting of this Company was held last Wednesday, at the Offices, Katharine Street, Croydon—Mr. CHARLES HUSSEY, J.P., in the chair.

The SECRETARY (Mr. W. J. Russell) having read the notice convening the meeting, the report of the Directors was presented. It showed a divisible balance of £13,494; and the Directors recommended that £515 should be withdrawn from the reserve fund and added thereto, in order to make up £14,009, and that dividends at the rates of 14, 11, and 9 per cent. per annum (less income-tax) should be declared on the various classes of stock.

The CHAIRMAN, in moving the adoption of the report, remarked that unfortunately, for the first time since he had been a Director, they had to record a small diminution in the sale of gas, as compared with the corresponding half of the previous year; but it was only a decrease to a very slight extent—0·41 per cent. If they had been alone in this respect, they would have wanted to know from their Engineer how this state of things came about. But, looking round, they found other gas companies were in a similar position, having experienced a like diminution. In their case, they could not attribute it to the electric light, because it was not yet available; and he did not suppose any of those present would think that, when it was laid on, it would affect the Company. They knew the cause of the falling off in the sale of gas. When they compared the very mild winter of the past half year with the very severe winter of the corresponding period, they would not have to seek any farther to find the reason for the decrease they had experienced. The mildness of the weather was the sole reason for it. They had fixed 520 new meters for additional consumers, making a grand total of 10,185; and 222 additional gas-stoves had been supplied on hire—there being 3338 now in use. Consequently, they went on increasing in this respect. But, as he had before remarked, the weather had been so mild that people did not require so many stoves, or to use them for so many hours. The Directors had again to refer to the market prices of residuals continuing very low, which was a very serious state of things for all gas companies. They had lost in the sale of coke, as compared with the first half of 1895, no less than 2d. per hundredweight, which, upon the large quantity they sold, amounted to a very considerable sum—£2310. It was the same with sulphate of ammonia, which they used to look to for a good sum to go towards their revenue. There was a difference between this and the corresponding half of 1895 of £3 per ton, representing a decrease of £535 upon that article alone. But it was said that in every dark sky there was a little bit of blue; and, fortunately, they had a little blue to console them, for they had effected a saving of 1s. 8d. per ton under the contract for the purchase of coal made last year. This had given them £3320 odd to go against the losses referred to. They had adopted the automatic or "penny-in-the-slot" system for the supply of gas in Carshalton. It had been well taken up by the cottagers, and was going on very satisfactorily. In fact, he must congratulate them that Carshalton was not quite the bug-bear they might have been led to believe in taking over the district. It was going on very well. Turning to the capital account, they had spent £4236 in the past half year, of which £1170 was for new buildings (including the erection of a valve-house, £478), and payment on account of two new boilers, £350. New mains and services had cost £1341; additional new meters, £826; and new gas-stoves, £899. During the half year, they had sold by auction £5900 of "B" stock, which averaged £274 8s. 8d. per cent.; thus showing that some proprietors, and the public also, had faith

in the Company. But shares had since been sold, and had brought even more. This sale gave them no less than £10,162 16s. 10d. upon which they paid no dividend whatever. The Directors recommended that £515 should be withdrawn from the reserve fund. They regretted very much to have to do so; but, of course, they could not take off 1d. per 1000 cubic feet in the price of gas, and 3d. per quarter in the hire of meters, without expecting something of this sort to occur. When they made these reductions, they were in prosperous times, and able to do it. They thought it would be a good thing to allow them; being desirous to make the Company as popular as possible. Being thus liberal, the consumers were satisfied. To give the shareholders some idea of the effect of this on the accounts, he stated that the reduction of 1d. per 1000 cubic feet in the price of gas entailed a loss of £1177; and the 3d. taken off the meter-rent resulted in a loss of £246. They would therefore see that a considerable sum had been given to the consumers in the shape of the concessions he had mentioned. They might have noticed the large amount put down in the revenue account as rates and taxes—£3130 16s. 6d. This seemed a considerable sum; and in future it would be only about £2309 in the half year.

Mr. T. RIGBY seconded the motion; saying that, on the face of them the accounts did not look so well as the shareholders might wish. But, after the Chairman's explanation, he thought they would be considered satisfactory.

Mr. A. B. WARD remarked that this was the first time for some years that any shareholder had had an opportunity to be dissatisfied with the state of things. When he saw that in the last half year the Directors put £1000 to the insurance fund, £1700 to the reserve fund, and carried forward £4000, he could not understand how this amount had been absorbed. This was the first time that a withdrawal from the reserve account had occurred; and he could not see where the money had gone.

The CHAIRMAN explained that the £4000 was absorbed last year. He thought that anyone taking into consideration the extraordinary mild weather of the past six months would see that the Company had come out of it well. Mr. Ward had lost sight of the fact that they had reduced the price of gas and the charge for meters.

Mr. WARD added that it was a question of policy whether the reductions were not made a little too hastily.

The CHAIRMAN replied that the Directors did not think so; and he believed there would not be the slightest necessity for drawing on the reserve fund in future. They had drawn upon it once before; but that was an exceptional occasion, when they had to go outside their contract to buy coal.

The motion was carried.

Mr. CORBET WOODALL, M.Inst.C.E., then moved that the dividends recommended be declared. He said that, if anyone could be so ungenerous as to take exception to the Chairman's speech, he should say that it was too apologetic. He believed that the accounts were very satisfactory. They had insurance and reserve funds amounting to £40,000 wherewith to equalize dividends. They had reduced the price of gas, and had no reason to regret it. It was called for at the time; and it had had its due effect. There had been a large increase in the number of consumers; and this would tell upon them from half year to half year.

Mr. G. J. B. JACKSON seconded the motion; and it was carried unanimously.

A vote of thanks was accorded to the Directors, as well as to the officers and staff, and the proceedings terminated.

BARNET DISTRICT GAS AND WATER COMPANY.

The Half-Yearly Meeting of this Company was held last Friday, at the Albion Tavern, Aldersgate Street, E.C.—Mr. JAMES GLAISHER, F.R.S., in the chair.

The SECRETARY (Mr. Alfred Lass, F.C.A.) having read the notice convening the meeting, the Directors' report and the accounts, to which reference was made in the "JOURNAL" last week, were taken as read.

The CHAIRMAN, in moving the adoption of the report and accounts, remarked that there was really not much to say in regard thereto. With respect to the gas portion of their business, they had realized from the sale of gas in the past half year £502 less than in the corresponding period of the preceding year; and the receipts from residual products had been £282 less. The total revenue from gas was £8389; being £765 less than in the corresponding half of last year. Turning to the other side of the accounts, as they had not made so much gas, they had not paid so much for coal by £420. The total expenditure on the gas portion of the undertaking had been £5805, as against £6310 last year; so that the gas profits were £260 less than in the corresponding six months of 1895. It must, however, be borne in mind that from March there had been a reduction in price which would very nearly account for this deficiency. Then, again, the severe winter of last year greatly increased the demand for gas; whereas the fine weather experienced during the early part of this year had had a contrary effect. This reduction was an unpleasant thing; but though the consumption of gas in the quarter to Lady-day last was less than in the preceding year, it was greater than in the corresponding three months of 1894 by 565,000 cubic feet. The whole of the diminution had taken place in the quarter to Lady-day; and he therefore thought that, though the profit was less, the gas accounts should be regarded as very satisfactory. Turning to the water accounts, it would be seen that in the quarter ending March the water-rates showed an increase of £223; and during the same period the amount received for meter supplies had been £156 more. The total receipts on water account during the half year amounted to £9618, as against £8866 in the previous year, or an increase of £752. With regard to expenditure, £167 more had been spent on repairs and maintenance of works, &c.; but the outlay on mains was £593 less. It must, however, be remembered that, owing to frost, the expenditure under the latter head was last year unusually heavy. There had been some special expenditure incurred during the half year for inquiries. One of these was with respect to the fittings to be used with the contemplated constant supply at Friern Barnet; and this inquiry cost £136. There was another at Potters Bar, where it was proposed to construct a sewage farm which the Directors thought would contaminate the water that passed into the chalk; the amount expended on this inquiry being £228—or a cost for the two inquiries of £364. The profit on water account during the six months had been £5742, as against £4837; showing an increase of £905. There was a steady progress in their gas business; and he thought he might say there was just as steady a progress in the water portion of the undertaking. The past half year had, however, been a period of great anxiety, for there had been a water famine. At Barnet, the rainfall between January and May had been only 5·4 inches, as against 5·8 inches in the same five months of 1895. There had only been one instance in the past 81 years of a less rainfall at Greenwich than that which was measured during the first five months of this year. They had struggled hard against their difficulties, and until July, they kept up their full supply as usual. They then, however, made application to the New River Company for assistance; but the answer they received was that, in view of the enormous demand existing in their own district, the New River Company did not see their way to give them a supply. They then asked the Local Authorities to discontinue watering the roads, and sent a circular out to the consumers asking them to be as careful as possible in the use of water. He was glad to say that this had the desired effect; and the following week showed a marked reduction in the quantity of water consumed. With regard to the Potter's Bar well, this had already been sunk to a depth of 245 feet; and they contemplated making this well 300 feet deep. They expected a yield of a million gallons a day from the well. They were resolved, at whatever cost, never again to subject the residents to the inconvenience they had suffered this year.

Mr. C. HORSLEY, J.P., seconded the motion.

Mr. PEAT inquired whether there was any possibility of the "B" shareholders receiving a dividend of 10 per cent.

The SECRETARY explained that the "B" shares were only entitled to a dividend of 1 per cent. less than that paid on the "A" shares, until 10 per cent. was paid on the latter, in which case the further profits would go to make up the dividend on the "B" shares to 10 per cent. In reply to a further question, he stated that the unaccounted-for gas amounted to about 6 per cent. of the make, which compared very favourably with other similar undertakings throughout the country.

The motion was then carried unanimously.

Dividends were then declared at the rate of 9 per cent. per annum on the "A" and "C" stocks, 8 per cent. on the "B" stock, and £6 6s. per cent. on the "D" capital gas and water stocks.

The CHAIRMAN proposed a vote of thanks to the officials (Messrs. Lass, Martin, and Wright) and their staffs; remarking that all had done their very best during the most trying time through which they had passed.

Mr. A. H. BAYNES seconded the resolution, which was carried unanimously.

On the motion of Mr. DYER, seconded by Mr. W. B. RANDALL, a vote of thanks was passed to the Chairman and Directors; and the proceedings then terminated.

PROVINCIAL GAS AND WATER COMPANIES.

Gas Companies.

At the half-yearly meeting of the Bristol Gas Company last Friday, the Chairman (Alderman J. W. S. Dix), in moving the adoption of the report, with the accounts for the six months ending June 30, noticed last week, remarked that, notwithstanding the extraordinary weather, which had told so much against all gas companies, they had been able to carry on their business very successfully; earning a dividend, and carrying over a satisfactory balance. The surplus on the revenue account, after paying dividend and interest on debentures, would be £3075, which was very good indeed, everything considered. Within the last two years, the cost of gas had been reduced 4d. per 1000 cubic feet; and the Directors hoped, as they had reasons for doing, that they would be able to still further lessen it. Their intention was to do it as soon as they could; and he trusted that before the shareholders met again the Directors would be able to announce that they had lowered the price 2d. There was an increase of 736 in the number of gas-stoves in use, which was satisfactory; and they looked for a further development of this branch of business, because the acquisition of one stove always led to others being required. They also had a satisfactory account respecting the use of prepayment meters—a thing of which he had a very great idea at the beginning. He thought they would be able to push that; as it meant the introduction of gas into smaller houses. He did not hesitate to say—and it might be said without egotism on one's part—that last half year had been eminently successful. Mr. G. K. Stothert seconded the motion; and it was carried. The Chairman then proposed the reduction of the number of Directors to six; and this was agreed to. A subsequent motion to reduce their fees by £250 per annum was, however, rejected in favour of an amendment to keep them at the present figure. A dividend of 5 per cent. was then declared; and the proceedings closed with votes of thanks to the Directors, Secretary (Mr. J. Phillips), and other officials.

In the report which the Directors of the Dover Gas Company will present to the shareholders at their meeting on the 7th prox., they state that the whole of the public lamps lighted by the Company have now been fitted with incandescent burners, which have not only proved a grand success, but have given great satisfaction to the public. It is usual to compare the result of the sale of gas with that of the corresponding half of the previous year. But the Directors say it would not be fair to do so on the present occasion, because there was an abnormal advance in the use of gas in the early part of 1895, in consequence of the long continuance of severe cold and dark weather. However, making the comparison with the first half of 1894, there is a slight increase in the quantity of gas sold, which, under the circumstances, is satisfactory. The result of the working is that, but for the

sum charged in respect of the alteration of burners, the profits of the six months ending June 30 would have sufficed to pay the usual dividend. As it is, they recommend the declaration of the full parliamentary dividend of 7½ per cent. per annum, less income-tax, by drawing £71 from the surplus profit account.

The report of the Directors of the Heckmondwike Gas Company states that there has been a continued increase in the consumption of gas. The profit for the half year ending June 30 is set down at £1542, which, with a balance of £3091, makes £4633. From this sum is taken the interest on loans, and the interim dividend paid in March, amounting to £1300; leaving £3333 available for division. This allows the payment of the full statutory dividends, and leaves a balance of £1574 to go to the next half-year's account.

In the report to be submitted to the shareholders of the Morecambe Gas Company at the annual meeting next Monday, the Directors state that the consumption of gas materially increased during the year ending June 30, and the total make of gas now amounts to nearly 40 million cubic feet. On the other hand, the price of sulphate of ammonia has fallen; and the receipts of the Company from this source are nearly two-thirds less than last year. The balance of the year's working, after payment of interest on the preference stock and mortgages, &c., amounts to £1999. To this must be added the balance from last year of £306; making an available balance of £2305. Out of this, an interim dividend of 5 per cent. (£1000) was paid in March last; and the Directors now recommend a further dividend of 5 per cent., making 10 per cent. for the year, free of income tax—leaving a balance of £305. The Directors propose to reduce the price of gas by a sum equivalent to 3d. per 1000 cubic feet, which will be allowed to consumers who pay their accounts within 28 days from delivery, and will come into operation from the 1st of October next. Under the supervision of Mr. Duff, the Secretary and Manager, 4155 tons of coal were carbonized; the estimated production of residuals being: Coke, 2596 tons; tar, 51,819 gallons; ammoniacal liquor, 40,839 gallons. Sulphate of ammonia to the extent of 18 tons 17½ cwt. was manufactured. Of the 39,346,500 cubic feet of gas made, 36,801,500 cubic feet were accounted for.

The half-yearly meeting of the Ossett Gas Company was held last Thursday. Mr. J. Ward (the Chairman of the Directors) presided. The Directors reported a slight increase in the consumption of gas; the balance carried to profit and loss account being £1918. The report was adopted; and the usual dividends were declared at the rate of 10 per cent. on the "A" shares, and 7 per cent. on the "B" shares. These absorbed £1730. Votes of condolence with the family of the late Chairman of the Company (Mr. Statter, of Wakefield) and of thanks to the Directors were passed.

The half-yearly general meeting of the Rochester, Chatham, and Strood Gas Company was held on the 13th inst.—Mr. J. R. Foord presiding. The balance-sheet showed receipts for the six months ending June 30 of £28,580; the net profit being £3024. A dividend at the rate of 10 per cent. per annum was declared on the "A" and "D" shares; and at 7 per cent. on the "B" and "C" shares.

The half-yearly meeting of the Wakefield Gas Company was held on Monday last week—Mr. Thomas Howden presiding. The Chairman moved the adoption of the report, which recommended dividends ranging from 8½ to 11½ per cent. on the different shares; the amount available for the purpose being £6113. He pointed out that though several millowners had adopted the electric light, there was no perceptible decrease in the consumption of gas.

The Directors of the Wellingborough Gas Company, Limited, reported to the shareholders yesterday that, notwithstanding the very mild season, there had been an increase in the consumption of gas in the six months ending June 30 last, though not sufficient to cover the loss sustained by the reduction in price. The income had, moreover, been considerably reduced by the low returns from coke and sulphate of ammonia. The balance available for division was £2014; and the Directors recommended the usual dividends of 5½ per cent. on the "A" and "B" shares, and 4 per cent. on the "C" shares, free of income-tax. With regard to working, the returns for the half year ending June 30 can scarcely be taken, owing to a variation in the date of the meter readings at Christmas. We therefore give the figures for the year. The quantity of coal used was 6156 tons; gas made, 66,582,300 cubic feet; gas accounted for, 64,642,000 cubic feet; gas sold, 64,115,000 cubic feet; gas unaccounted for, 2·91 per cent. The make per ton of coal was 10,815 cubic feet, 10,500 cubic feet of which were accounted for and 10,415 cubic feet sold. Of the coke produced, 9 cwt. 2 qrs. 17 lbs. were available for sale. The capital expended on the works comes to £6 10s. 9d. per ton of coal carbonized.

The 50th half-yearly general meeting of the Westhoughton Gas Company was held on the 13th inst., under the presidency of Mr. W. C. Buckley, the Chairman of the Company. The report and accounts for the half year ending June 30 were unanimously adopted. From these it appeared that during the six months the total receipts on revenue account amounted to £1785, while the aggregate expenditure was £997. After deducting the interest payable on loans, there remained a balance of £603, out of which the Directors recommended the declaration of a dividend at the rate of 5½ per cent. per annum, free of income-tax (this being ½ per cent. more than for the past two or three half years, and the largest paid for a very long time); a small balance being carried over. This was agreed to. After some other business, the proceedings concluded with votes of thanks to the Chairman, the Directors, and the Secretary—specially complimentary remarks being made as to Mr. Pickup's efficient services on behalf of the undertaking. The question of the proposed purchase of the Company's works by the Westhoughton Urban District Council did not come under consideration.

Water Companies.

The half-yearly meeting of the Brompton, Chatham, and Gillingham, Water Company was held on the 13th inst.—Mr. J. Baird (the Chairman) presiding. The gross water-rental amounted to £9831 for the six months ending June 30, out of which £1013 has gone back to consumers as discount, and £600 been put to the reserve fund. The Directors recommended the payment of a dividend at the rate of 10 per cent. per annum; and this was agreed to. At an extraordinary meeting subsequently held, it was resolved to raise additional capital to the extent of £6000, in shares of £5 each.

The Chester Water Company held their half-yearly meeting on the 13th inst., under the presidency of the Deputy-Chairman (Mr. F. E. Roberts). The report for the six months ended June 30 stated that there was a surplus of revenue over expenditure of £2626, which, added to the balance brought forward, made £9194. The interest on the preference capital required £450; leaving £8744, which it was recommended should be appropriated to the payment of a dividend at the rate of 7½ per cent. per annum, free of income-tax, upon the consolidated stock, and 7 per cent. per annum upon the new ordinary stock, amounting to £1890. The report was adopted; and the dividends recommended were declared.

The Wrexham Water Company held their annual general meeting on the 11th inst., when the Directors reported that the receipts on revenue account for the year ending June 30 showed an increase of £415 as compared with the preceding twelve months. Water was laid on to 325 houses; making a total of 4193 houses supplied. The expenditure on capital account during the past year, amounting to £3161, included the remainder of the cost of laying the 12-inch trunk main to Wrexham, and also for some additional distributing mains. Payments were also made on account of the new works in hand for securing an additional supply of water. To meet these expenses, 600 ordinary shares were issued, which were readily taken up by the proprietors. The charges for repairs and maintenance included the costs incurred during last autumn in completing the relaying of mains and service-pipes damaged during the severe frost. After payment of these exceptional charges, the full dividends upon the preference shares and stock, the interim dividends of 5½ per cent. per annum upon the consolidated stock, and £3 17s. per cent. per annum upon the ordinary shares for the six months ended Dec. 31, 1895, and interest upon mortgages for the year, a balance of £2771 remained on the net revenue account. The Directors accordingly recommended the payment of the full preference dividends and dividends at the rate of 5½ per cent. per annum upon the consolidated stock, and of £3 17s. per cent. per annum upon the ordinary shares, all free of income-tax. The Chairman (Mr. W. Overton) moved the adoption of the report, and the motion was carried. Thanks were accorded to the Chairman and officials, and acknowledged by Mr. Overton and by the Engineer and Secretary (Mr. F. Storr).

The total income of the Yeadon Water Company in the six months ending June 30 amounted to £1398, and the expenditure to £457; leaving a net profit of £941. The sum available for distribution is £988; and the Directors recommend a dividend at the rate of 4½ per cent. per annum on the original capital, and of £3 3s. per cent. on the "B" stock. After the payment of these, there will be a balance of £162 to be carried forward.

GLASGOW CORPORATION GAS AND ELECTRICITY SUPPLY.

The Annual Accounts.

The Gas and Electric Lighting Committee of the Glasgow Corporation have issued their annual report and accounts. In regard to gas supply, the Committee's report is the 27th; and it deals with the year ending May 31. In the course of it they show that the gross revenue amounted to £605,794; and the gross expenditure, to £472,845. Adding to the latter sum the amount of depreciation written off capital, £66,156, there is produced a total of £539,001; leaving a balance of £66,793 to go to the profit and loss account. The Committee had to pay during the past financial year £33,603 annuities on stock, £27,487 for interest on borrowed money—together, £61,090—and £5200 to the sinking fund; making altogether £66,290, and leaving a surplus of £503 on the year's operations. With the balance brought forward (£120), and the surplus on the electric lighting account (£2381), a total of £3004 was produced, of which £3000 has been transferred to fire insurance, &c.; leaving £4 to be carried to the credit of the current year's account. The Committee's anticipation of a falling off of income from residuals for the past year was unfortunately realized. The reduction from this source is: For tar and liquor, £13,000; for coke, £5000—a total of £18,000. The average price received for tar and liquor was 2s. 6·67d. per ton of coal carbonized, against 3s. 3·63d. for the previous year; and for coke, 5s. 1·98d. as compared with 5s. 5·23d. The Committee, as usual, advertised for tenders for coal to be supplied during the current year; and they have concluded contracts at prices slightly under those previously made. Having regard to this fact, and to the favourable balance now submitted, the Committee recommend that the price of gas be reduced from 2s. 4d. to 2s. 2d. per 1000 cubic feet; this reduction to take effect retrospectively as from the date of the last survey. The quantity of gas sold or accounted for during the past year was 4,259,169,000 cubic feet; being an increase of 5·71 per cent. as compared with the year 1894-5. The sinking fund, with its accumulations, now stands at £313,827.

With respect to electric lighting, the Committee state that the gross revenue in the past financial year amounted to £25,862; the gross expenditure, to £11,590. Adding to the latter sum the amount written off capital for depreciation (£6329), there was produced a total of £17,919; leaving £7943 to go to the profit and loss account. The Committee paid £4246 for interest, and added £1316 to the sinking fund; so that there was a surplus of £2381 on the year's operations. This, in accordance with the terms of the Provisional Order, is transferred to the credit of the gas account. This very gratifying result, the Committee remark, shows that their anticipation that there would be a credit balance when the plant was in full operation, has been amply fulfilled. In view of the favourable balance shown, they have approved of the recommendation made by the Special Sub-Committee on the Proposed Extension of Electric Lighting Works and Plant, to the effect that a reduction in the price of current on a scale which necessitates a new method of charging should take effect as from the 1st of June last. This new method the Committee anticipate will increase the popularity and use of the electric light. Indicators will be placed in customers' premises to ascertain the greatest quantity of electricity

taken at any one time during the year, which quantity is called the "maximum demand." To customers who use in the twelve months the maximum demand for 365 hours only—being an average of one hour per day—or any lesser quantity, the price charged will be at the same rate as at present—viz., 6d. per unit; but for all electric energy used over this quantity, the charge will be at the rate of 4d. per unit. The Committee have also approved of the further recommendation made by the Special Sub-Committee that the charge for meter hire be discontinued from and after the 1st of September; and that so soon as the current for the supply of street lamps is taken from Waterloo Street station instead of John Street station, the price charged for each lamp should be reduced from £26 to £20 per annum. The number of consumers on the 31st of May was 855; being an increase of 269 over the number at the corresponding date in 1895. The quantity of electricity sold to private consumers, irrespective of public lighting, was 866,606 units; being an increase at the rate of 24·11 per cent.

The accounts referred to above were presented at a meeting of the Corporation last Thursday, at which Lord Provost Sir JAMES BELL presided.

Mr. FIFE, the Convener of the Gas and Electric Lighting Committee, said the reports gave very full details connected with the working of both departments named; and it must be a source of gratification to all concerned that the year's work had resulted in very favourable financial balances. Last year the gas department was able to recommend a reduction in the price of gas of 2d. per 1000 cubic feet—from 2s. 6d. to 2s. 4d.; making a saving to the consumers of £32,237. This year the Committee saw their way to make a further reduction, from 2s. 4d. to 2s. 2d., meaning an additional saving of £34,867. When the Corporation took over the works in 1869, the price charged for gas was 4s. 3d. and 4s. 4d. per 1000 cubic feet. One important feature of their operations was that the lower the price the greater the demand for gas. This year the quantity made was 4,811,084,500 cubic feet; last year 4,525,265,500 cubic feet—being an increase of 286,619,000 cubic feet. The coal carbonized this year was 516,351 tons; last year, 487,382—increase, 28,969 tons. The average price was 9s. 1⅞d. per ton this year, against 10s. 7½d. last year. Also 209,000 gallons of crude oil had been used. The illuminating power of the gas, as per Mr. Tatlock's report, was 21·31 candles and 21·39 candles respectively. As to the works, the Council must be prepared at a very early date to support Mr. Foulis in any recommendation he might make as to a reconstruction or extension at Dalmarnock. If the same appliances had been at work there during the year as were in operation at Dawsholm and Tradeston, an additional saving of 1s. per ton on the coal carbonized (amounting to £7500) would have resulted in the working expenses. In the electric lighting department, the Committee all along felt satisfied that they were working on good sound financial lines; and these had now been verified by the results of the past year's work—turning the deficiency of last year of £1527, into a surplus this year of £2380, and this after providing amply and fairly for depreciation and the sinking fund. They believed they had in the Waterloo Street works one of the best electric lighting stations for its size in the country. In order to develop its utmost producing powers, the Committee (after very careful investigation by a Sub-Committee) recommended a change in the mode of charging: First, to abolish the charge for meter-rents, a saving of some £800 per annum to the consumers; and, second, that the price be 6d. per unit for the first hour of each day, and 4d. per unit for every hour thereafter, thus meeting the case of those who use the current for a longer time, and which would enable the plant to be worked with more regularity and economy. They asked that this (the Brighton) system should have a fair trial, as, so far as could be judged, it might lead to other reductions in the future. There was the further recommendation to reduce the price of each public lamp from £26 to £20—the lowest in the kingdom, for a continuous light of the power now furnished.

Mr. MITCHELL seconded the adoption of the report. He remarked that they could recommend the reduction without at all interfering with the way in which they had always liked to carry on the business of the Committee.

Baillie BURT thought they ought to congratulate themselves very heartily that the price of gas was down to 2s. 2d.; and he hoped the time was not far distant when they would reach 2s. He was satisfied the reduction in price would result in an enormous increase in the demand for gas. He was well aware, from conversations that had taken place in the Gas Committee, that at the present moment the works were at their full capacity; and he felt sure that Mr. Fife's remarks regarding early expansion and addition, would require to be faced without delay. In connection with the electric lighting, he also felt pleased that they were able to propose a reduction. Regarding the change in the mode of charging, the Committee felt that they ought to give a reduction to customers who were likely to use the light for a lengthened time each day; and that they ought to encourage the use of electric motors during the day, so that the man who used current from eight to ten hours per day should have it comparatively cheap. He felt sorry for the delay in settling the question of electric tramway traction. If the city of Glasgow could adopt some method of electric traction that would present a solution of the electric lighting question that could not be attempted under existing circumstances, they could then have a continuous flow of current from 12 to 14 hours a day that would reduce the standing charges so much that the price could be lowered greatly. In the solution of this question, he felt that they had not only the solution of electric tramway traction, but also of the lighting of the city. He had not the slightest fear of gas and electric lighting coming into rivalry. So far as gas was concerned, there were enormous outlets for it. If they supplied gas at a cheap rate, they might have the majority of the citizens using it instead of coal; and they might have it used more as a heating agent. He was satisfied that they really were in the front so far as the electric lighting system was concerned. The question for the Committee next year would be whether they should acquire more ground and extend the Waterloo station, or institute small stations throughout the city.

Mr. FERGUSON wanted to know if the Corporation considered it necessary to pay interest upon borrowed money to the extent of 9 and 6¾ per cent. The Island of Guernsey, he said, issued (upon the security of the community) notes which enabled them to borrow without paying interest. The Glasgow Corporation might do likewise, and issue notes for the amount they required, seeing that they had 4½ millions of taxable income behind them. Why, he asked, had they carried forward from the profits on electric lighting the sum of £2380 to the gas accounts? Should not this money go to the development of the electric light?

Mr. FIFE said it might seem anomalous that they should carry the surplus of the past year from the electric lighting to the credit of the gas account; but they were acting in accordance with the Provisional Order. Besides, the gas department during the three previous years had to bear the deficiency of electric lighting. The deficiency in the first year was £1773; in the second, £607; and in the third, £1527. The £2380 was the first sum paid from the electric lighting to the gas account on account of this deficit. Whenever the accounts were right the consumers of electric light would have full benefit.

Bailie PATON argued that the accounts did not justify the reduction which had been made in the price of gas, and that it would be unfortunate if they had again to raise the price.

Mr. MITCHELL said that the Committee had fully considered the matter, and had concluded that they were justified in making the reduction.

The reports were adopted.

At a previous stage of the proceedings,

Mr. FERGUSON asked whether there could not be given a statement as to the comparative cost of gas and the electric light. There seemed to be confusion on the subject.

Mr. MITCHELL: I think the cost of the electric light is 2½ times more than gas.

The CHAIRMAN: My experience is that it is more than that.

Bailie DICK asked whether the report on electric lighting meant that the Corporation were committed to the erection of large electric works; and he asked that nothing should be done without further consideration.

Mr. FERGUSON said he would like to bring before the Council a matter which had been a good deal talked of in private, and which he thought should also be talked of in public—as to the division of the two departments of gas and electric lighting. He did not think that Glasgow was in the most satisfactory position with reference to electric lighting.

The CHAIRMAN (interrupting) said this question did not arise out of the minutes.

Mr. FERGUSON thereupon said he would bring the matter up in the form of a notice of motion.

ELECTRIC LIGHTING NOTES.

In a previous issue of the "JOURNAL" (*ante*, p. 279), we gave the principal points in a report presented by the Electrical Engineer at Plymouth—Mr. J. H. Rider—furnishing the outlines of a scheme of electric lighting and tramway traction for the borough, the initial cost of which is put at £46,000. At a recent meeting of the Borough Council, the Electric Lighting Committee recommended the adoption of the report, and suggested that application should be made to the Local Government Board for power to borrow £45,000 for carrying out the work. A sum of £1000 has already been applied for. Mr. J. Willoughby, in moving the adoption of the recommendation, said there was not a single member of the Committee who would raise his finger to assist the scheme if it were not thoroughly understood that every inch of the tramway was to be operated by electricity at the earliest date. It was not possible, however, to do the whole of the work at once. Referring to the question of income and expenditure, he said that, if the Corporation were a lighting company setting about the work, they could get a return of 5½ per cent. on the first year's working. Questions had been asked as to the relative meaning of an electrical unit, as compared with the method of measuring gas. He had heard Mr. Siemens, the well-known electrician, say that electricity in Bournemouth at 8d. per unit cost the same as gas at 3s. per 1000 cubic feet. They in Plymouth put the price of electricity at 5½d. per unit, which would be equal to gas at 2s. 3d. Mr. Elliott questioned whether they would be justified in spending 2½ times as much in lighting the town with electricity as they were now spending on gas. In view of the fact that the report only provided for an instalment of the work at a great cost, he thought that, before the Council committed themselves to anything, a comprehensive statement as to the approximate total cost should be presented. Mr. J. Yeo remarked that, while for business purposes the electric light would be a good thing, he failed to see the wisdom of incurring a cost of £1184 for public lighting when this was done at the present time for £475. Mr. Willoughby said the experience of other towns was that the more electric light was used, the greater was the consumption of gas. There could not be a doubt that the lighting of Plymouth by electricity would make it one of the most attractive places in England; and it should not be forgotten that the more the light was adopted, the cheaper it would become. It was calculated that there would be a saving ultimately of £4000 per annum by the substitution of electric for horse power for the tramcars. The buildings it was proposed to erect would be sufficient to permit of the scheme being extended all over the town; but the plant would not. It would be possible to supply the hotels and public buildings with electricity up to a maximum of 12,000 lights. After some conversation, the recommendation was adopted—an amendment to defer its further consideration till after the November elections not finding a seconder.

The Local Government Board have declined to sanction borrowing powers for £20,000 to enable the Eccles Town Council to carry out their electric lighting scheme. Mr. G. W. Willcocks, M.Inst.C.E., held an inquiry on the subject at the Town Hall on the 3rd of June, when considerable opposition was raised to the application by several members of the Council, and by the Eccles Property Owners' and Ratepayers' Associations. The inquiry lasted two days; and at the hearing the Town Clerk informed the Inspector that the Board of

Trade had agreed to extend the Provisional Order for twelve months from the 12th of June. The scheme has been the subject also of much opposition at the Council meetings, and was only carried by the casting vote of the Mayor. Since then, two members have been elected to oppose it; so that there is now a majority of dissentients on the Council.

Two schemes of electric lighting are before the ratepayers of Bury St. Edmunds; and though a worthy Alderman has undertaken, in connection with one project, to guarantee the town against loss, it has not been received very warmly. In fact, the inhabitants of the town do not want electric lighting; and they have gone so far as to "demonstrate" against it. Last Thursday week, under the auspices of the Bury St. Edmunds Ratepayers' Association, a procession, headed by bands and banners, paraded several streets till they reached the Cornhill, where several hundred people assembled. The Rev. J. F. Kennard presided, and explained that the demonstration had been organized to protest against the proposal to spend upwards of £20,000 upon the electric lighting scheme adopted by the Town Council. He had no objection to private enterprise; and if the undertaking proved successful, let the promoters of a private company share the profits, if they were willing to undertake the risks. The Ratepayers' Association was not intended to hinder progress; but it would be a strange perversion of progress which would involve the ratepayers in a burdensome debt. Mr. D. B. Capon moved a resolution to the effect that that monster public meeting of ratepayers protested against the Town Council adopting the scheme for lighting the borough by electricity, and pledged themselves to oppose by every legitimate means the carrying out of the project. Mr. W. G. King, in seconding the motion, said he objected to the Town Council incurring an outlay of £20,000 upon an electric lighting scheme, when five-sixths of the ratepayers were opposed to it. He would much prefer to see private enterprise embark upon such a speculation. Mr. H. Bankes Ashton argued against the electric lighting project; and, in the course of a vigorous speech, he insisted that the ratepayers' opinions should have been tested by a poll. He contended that it was unwise at present to embark upon such a speculation as a public undertaking. Mr. E. Weston dealt with the financial aspect of the question, which he considered fallacious. He also spoke adversely to the electric light as being injurious to the eyesight. The resolution, which was carried with few dissentients, will be forwarded to the Local Government Board, in support of the petition receiving signatures against the electric lighting scheme.

The Ipswich Corporation have had before them a report from the Electric Lighting Committee on the reference to Professor Kennedy of a question as to providing electric lighting for certain areas of the borough. Two estimates were submitted—one of £30,200, and another of £41,900 for a more extended area. A suggestion was put forth to have a dust destructor in combination with the electric lighting scheme. The matter was ordered to stand over till the next meeting.

When referring, in a paragraph in the "JOURNAL" last week, to the report of the Electricity Committee of the Newport (Mon.) Corporation for the year ending March 25, which was recently presented to the County Council, we stated that it showed a profit of £180. It has been pointed out that this was realized after paying working expenses only, without any provision being made for interest and sinking fund. As this payment amounts to £1590, there is really a net deficit of £1410.

The Canterbury Town Council have already begun to get into a tangle over the electric lighting scheme, for which so much has been promised by the promoters. At a meeting of the Council last Wednesday, Mr. R. Hammond, the Electrical Engineer, had his final plans and estimates of the electric lighting works and dust destructor placed before the open Council for adoption; and it then transpired that the Lighting Committee had practically authorized the issue of advertisements for tenders for the works. Alderman Cross, however, pointed out that it was proposed to erect the dust destructor in Miller's Field; and he said he understood the majority of the Council were against this. Alderman Mason said Mr. Hammond had advised the site. Mr. Harris then drew attention to the fact that Miller's Field had been purchased with the ratepayers' money for the purposes of a recreation-ground, and not for the erection thereon of electric lighting works or dust destructors; while as for the necessity of a dust destructor, he could not see any at all, because their sewage farm was actually "hungry" for the town refuse. Alderman Mason said they only proposed to use a corner of the field. Mr. Stead doubted if the Corporation had a right to build on the field. The Town Clerk (Mr. Fielding) said it was purchased with money borrowed for "no particular purpose" except to buy the land. Mr. Harris said nothing had been decided, so far as he knew, about the destructor. The Town Clerk said the whole of the plans had been passed; and the destructor was included. It was eventually resolved to "leave the dust destructor out of the scheme." The Town Clerk said he really did not know what to do now. The plans, with the dust destructor forming a part of the scheme, were all prepared, and everything was ready for the reception of tenders; and now the Council had done something which would prevent them being asked for. He appealed to the Council whether the matter should not go on, as they could afterwards accept the tenders or not as they thought fit. Mr. Harris said he should not give way; whereupon Alderman Mason asserted that the vote just taken was illegal, as they would have to rescind a previous resolution before they could leave out the dust destructor. It was in the end resolved to refer the whole matter back to a special meeting, and take no minutes of the present proceedings.

Projected Extensions at the Colne Gas-Works.—A Local Government Board inquiry has been held by Mr. Walton in reference to an application of the Colne Corporation for power to borrow £12,000 for extensions, alterations, and improvements at the gas-works.

The "M.W.P." Carburetted Water-Gas Plant.—The plant which the Economical Gas Apparatus Construction Company, Limited, are erecting at Birmingham and Birkenhead for the production of carburetted water gas is progressing very favourably at both places. The use of the Company's system is also extending, as the New Swindon Gas Company have recently given them an order for plant to manufacture from 100,000 to 150,000 cubic feet of gas per day.

CHESTER WATER SUPPLY.

The Water Company and the Sluices Bill.

The holding of the ordinary half-yearly general meeting of the Chester Water Company on the 13th inst., as recorded elsewhere, afforded the Deputy-Chairman (Mr. F. E. Roberts), who presided, an opportunity of explaining the position of the Company in regard to the Bill promoted by the Corporation to enable them to carry out certain works for preventing the pollution of the River Dee. He said the difficulty experienced by the Board was in coming to a decision as to the attitude the Company ought to assume towards the Bill, having regard to the feeling existing in the town; and they decided to present a petition against it. Their object was honestly and really that they might obtain proper protection and the introduction of proper clauses into the Bill, and that they should not be unfairly treated financially. The Directors had over and over again expressed their willingness to meet the Corporation financially or otherwise in any well-devised scheme for doing away with the pollution of the upper reaches of the river; but they had felt that the greatest pollution below the city came from the works established by the Town Council, and that therefore they were not called upon to contribute towards any scheme for doing away with that pollution. They had a conference; and it was proposed that they should hand over £15,000 towards the expense of the scheme, and that they should also contribute towards the cost of maintenance. This was agreed to; and their opposition was practically withdrawn. Afterwards the Committee expressed their opinion that the clauses with regard to the pollution of the upper reaches were not justified; and they intimated their intention of declaring the preamble of the Bill, so far as they were concerned, not proved. The Directors, although they did not like the Bill, decided to adhere to their offer, with the exception of the withdrawal of the contribution towards maintenance. Ultimately the Bill was thrown out; and there the matter stood. The question was now what should be done for the future. The question of the water supply was being anxiously discussed in the Town Council; and it was natural the Company should receive some communication from them before long. They had reason to know that the public opinion that had been brought to bear upon the water question would result in the establishment of a Joint Committee, who, under the operation of the Rivers Pollution Act and the County Council Act, were supposed to have powers to deal with any contamination of this kind. The Town Council said they were prepared to do away with the pollution below, so far as they were concerned; and this ought to put the Company in a stronger position than ever. They did not really admit that the water supplied to the town could be materially improved. The reports of the Medical Officer, the public health, and the death-rate, all went to confirm this opinion. Further, in connection with the sluices scheme, they had taken care to have the most critical analysis made of the water, both chemically and bacteriologically, with the result that they were furnished with evidence which they were prepared to place before the Committee, and which would have established the purity of their water supply beyond all dispute. Sir Henry Roscoe was ready to assert that the Chester water supply was equal to, if not better than, that of Manchester, which came from Thirlmere. What more did they want? They made the offer they did because there was a scare about the water, and public opinion had to be met.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

As they are given in another column, the annual accounts of the Glasgow Corporation show what a wonderful elasticity there is in the gas industry. A reduction of 2d. per 1000 cubic feet last year brought about a very large increase in the demand for gas. This increase is given as 286 million cubic feet; but it is overstating the matter to attribute it all to the influence of price. There can be no doubt that, in a progressive city like Glasgow, with trade as it has been during the past twelve months, there would without this reduction have been a considerable increase—probably about half of what was in reality experienced; but certainly price had a great deal to do with the increased volume of business. It is almost cause for wonder how it was possible to get so much coal through works which were not so very much ahead of the demands upon them, and also as to how much further they could be made to go. True, the Dawsholm extension was at work last year; and the Tradeston extension is in progress, both in the retort-house and the gasholder departments. Extensions are also spoken of at Dalmarnock, so it is clear that the necessity for keeping the works abreast of the consumption is not being lost sight of. Some idea of the progress which has been made in the equipment of the various gas-works in Glasgow is obtained when it is recollected that about three years ago a deputation from an English town—I think Leeds—was in the city viewing municipal arrangements and provisions, and it was to the Dalmarnock works they were taken, as being then the most complete. Since that time, the Arrol-Foulis stoking machinery has been introduced at Dawsholm and Tradeston; and coal breaking and conveying plant has been fitted up at the former, and is being introduced at the latter. The Dalmarnock works have become, in so short a space of time, the antiquated works of the Corporation—not, of course, that they are antiquated in the general sense of the term, but that they are not now able to hold their own with the others. The contrast will not, however, be of long standing, for it will be observed that it is already under consideration to bring the Dalmarnock works in line with the others; and it is material to note that, had the improved plant been in use there, there would have been a saving to the Corporation last year of 1s. per ton of coal carbonized, which would have amounted to £7500. There is matter for reflection here, which may be commended to those gentlemen whose purpose it is to create differences between workmen and their employers. It sounds very well to hear of a saving in the cost of production to the amount of £7500 a year;

but out of whose pockets does the saving come? Assuredly the workers. Taking the saving at 1s. per ton on the total quantity of coal carbonized, and deducting the £7500 which was not saved at Dalmarnock, there was a curtailment of workmen's wages to the amount of about £17,000 during the year. It is common knowledge that these labour-saving appliances would not have been invented or adopted had it not been for labour troubles. How, then, will it strike labour leaders when they learn that their doings have cost workmen, in one city alone, nearly £20,000 a year? Leaving this subject—which is more one for the political economist than for me—it is to be noted as one of the other proofs of the great elasticity of the gas industry that in Glasgow, notwithstanding a decreased revenue from residuals to the amount of £18,000, there was yet a surplus on the year's working. Of course, a decrease was estimated for; but such a large reduction of revenue might well have turned the accounts the other way, and in all probability would have done so had it not been for the greatly increased return from gas and the lower price paid for coal. There is a feature in the report on gas supply which has not been made very clear. It is stated that 209,000 gallons of crude oil were used. Part of it would probably be employed in the Humphreys and Glasgow carburetted water-gas plant; but this was out of use during the greater part of the year, and after that Mr. Foulis worked a pure oil-gas system. The results of the working are not given or indicated, either of the carburetted water gas or of the pure oil gas. It may be that in these days of competing oil gas and other enrichment processes, curiosity is apt to lead to expectations which it would not be advisable in all cases to gratify; but it is only by the communication of results by different processes that those who desire to adopt the best system may be guided. The price of gas has now been brought down to 2s. 2d. per 1000 cubic feet—the lowest it has ever been sold at in Glasgow; and, given conditions which are no worse than the present, there is a probability of the figure being reduced to 2s. This is good working; and there can be nothing but congratulation to Mr. Foulis and all under him upon the excellent results they have obtained.

As regards the electric lighting account, it is enough to show how very lightly it has as yet touched the fringe of the garment of the gas undertaking, to point to the revenues in each department. Gas realized £605,000; and electric lighting, £25,000. Even with this small sum, the electricians profess themselves to be delighted, as it leaves a balance of £2380. This is the first surplus they have earned; and it has been placed to the credit of the gas account, out of which the previous deficits were taken. One gentleman in the Town Council thought the surplus should have been devoted to the development of electric lighting; and I confess that, seeing the system of give-and-take between the two methods of lighting had been once introduced and acted upon, I sympathize with his view. The gas account could easily have done without the £2380; and if it were to do any good to the electric lighting adventure, it might as well have been left there. But it is so trifling that it really would have done little good; and so it matters little what became of the surplus. Of more importance is the new arrangement as to the price to be charged for current. The old rate—6d. per unit—is to remain for the first hour's use each day; and then it is to be reduced to 4d. per unit. I think this is not the best solution of the difficulty of propagating a sickly adventure. It furnishes a temptation to dodge the account by working only a small part of an installation during the first hour, at 6d. per unit, and then taking the supply for the full installation at 4d. per unit. In practice, I fear, it will be found that the proportion of fourpenny electricity will be greater than it should be, and that it would have been better financing to have made the price 5d. per unit all over. The charge for street-lamps is to be reduced from £26 to £20 a year. This sum will not pay the Committee. Where is the balance to come from? It is manifest that the deputations which have been sent out of late must have learned a good deal in their journeyings as to how to conduct an electric lighting adventure so as to make it appear prosperous. I would like to see a detailed account of some of these undertakings. Before leaving Glasgow subjects, I may glance at the conversation in the Town Council over the monthly minutes of the Gas and Electric Light Committee, and particularly at the statement that electric light costs 2½ times, or more, the cost of gas lighting. If business men in Glasgow find this to be so, what becomes of the statements of *dilettante* lecturers and dabblers in the matter, which frequently are to the effect that they find electric light to be cheaper than gas?

There was another subject before the Glasgow Town Council on Thursday, which deserves to be mentioned here. A workman in the employment of the Water Committee neglected an order by his foreman to place a light upon a heap of causeway stones which had been piled upon a public road, and an accident resulted, out of which arose three claims for compensation for injuries. These have been settled amicably for £775. In speaking on this subject, Bailie Paton pertinently remarked that they sometimes had grievances brought before them regarding the small wages of workmen; and he thought attention should be called to what had, in this case, to be paid on account of their neglect.

At a meeting of the Greenock Police Board on Tuesday, Mr. Samuel Stewart, the Gas Manager, reported upon the year's working in connection with the oil-gas process. The plant, he said, cost £1688, and is to be liquidated from revenue in four years. The repairs amounted to £197; while the cost of working had been £3000. The quantity of oil gas made was 15,606,620 cubic feet, of an illuminating power of over 90 candles. To produce the amount of gas made last year—250,484,000 cubic feet—the probable quantity of coal and cannel would have been about 26,000 tons. At an average price of about 11s. 6d. per ton, this would give a total cost of £14,950, as compared with an actual outlay for coal and gas oil of £13,726, or fully £1200 less. There was a deficit upon the gas accounts for the past year; but that was explained by the reduction in the price of gas a year ago by 2½d. per 1000 cubic feet.

On Monday of this week, the Forfar Gas Corporation considered

GAS AND WATER COMPANIES' STOCK AND SHARE LIST (see ante, p. 356).

Issue.	Share.	When ex Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p. c.	GAS COMPANIES.			£ s. d.
590,000	10	15 Apl.	10½	Alliance & Dublin 10 p. c.	25½–26½	..	3 19 3
100,000	10	,,	7½	Do. 7 p. c.	18–19	..	3 18 11
300,000	100	1 July	5	Australian (Sydney) 5% Deb.	108–110	..	4 10 11
200,000	10	12 June	5	Belgrano (B. Ayres), Limited	10–10½	..	4 15 3
100,000	Stck.	26 June	5	Do. 5 p. c. Deb. Stk	100–103	..	4 17 1
200,000	5	29 May	6½	Bombay, Limited	7⅞–8½	..	3 18 9
40,000	5	,,	6½	Do. New, £4 paid	5⅞–6	..	4 6 8
380,000	Stck.	13 Aug.	12	Brentford Consolidated	285–290*	..	4 2 9
210,000	,,	,,	9	Do. New	215–220*	..	4 1 9
50,000	,,	,,	5	Do. 5 p. c. Pref.	—	..	—
159,375	,,	12 June	4	Do. 4 p. c. Deb. Stock.	130–134	..	2 19 9
220,000	Stck.	27 Mar.	11	Brighton & Hove Original	247–252	..	4 7 3
208,820	,,	,,	8	Do. A Ord. Stk.	190–195	..	4 2 0
933,500	Stck.	27 Feb.	5	Bristol, 5 p.c. max.	128–133	..	3 15 2
420,000	20	27 Mar.	11½	British	57½–58½	..	3 16 11
50,000	10	12 Mar.	11½	Bromley, Ordinary 10 p. c.	22½–23½	..	4 17 11
71,000	10	,,	8½	Do. 7 p. c.	19–20	..	4 5 0
500,000	10	29 Apl.	5	Buenos Ayres (New) Limited	10½–10⅝	..	4 13 1
200,000	100	1 July	6	Do. 6 p. c. Deb.	103–106	+1	5 13 2
150,000	20	15 July	8½	Cagliari, Limited	29–31	..	5 6 5
100,000	10	29 May	8	Cape Town & District, Ltd.	16–17	–½	4 14 1
50,000	50	2 May	6	Do. 6 p. c. 1st Mort.	58–60	..	5 0 0
550,000	Stck.	15 Apl.	13½	Commercial Old Stock	345–350	..	3 17 2
165,000	,,	,,	10½	Do. New do.	260–265	..	3 19 3
165,000	,,	12 June	4½	Do. 4½ p. c. Deb. do.	152–157	+4	2 17 3
800,000	Stck	12 June	13	Continental Union, Limited.	285–290	..	4 9 8
200,000	,,	,,	10	Do. 7 p. c. Pref.	220–225	..	4 8 11
51,600	Stck.	27 Feb.	14	Croydon Com'cial A 10 p. c.	—	..	—
163,400	,,	,,	11	Do. B 7 p. c.	—	..	—
535,000	Stck.	27 Feb.	5½	Crystal Palace Ord. 5 p.c. Stk	140–144	..	3 12 11
60,000	,,	,,	5	Do. 5 p. c. Pref.	—	..	—
486,090	10	15 July	11	European, Limited	26½–27½	..	4 0 0
354,060	10	,,	11	Do. £7 10s. paid	18–19	..	4 6 11
5,746,590	Stck.	13 Aug.	12½	Gaslight & Coke, A, Ordinary	313–318*	..	4 0 2
100,000	,,	,,	4	Do. B, 4 p. c. max.	110–115*	..	3 9 7
665,000	,,	,,	10	Do. C, D, & E, 10 p.c. Pf.	300–310*	..	3 4 6
30,000	,,	,,	5	Do. F, 5 p. c. Prf.	147–152*	..	3 5 9
60,000	,,	,,	7½	Do. G, 7½ p. c. do.	212–217*	..	3 9 1
1,300,000	,,	,,	7	Do. H, 7 p. c. max.	205–210*	..	3 6 8
463,000	,,	,,	10	Do. J, 10 p. c. Prf.	300–310*	..	3 4 6
476,000	,,	,,	6	Do. K, 6 p. c. Prf.	173–178*	..	3 7 5
1,061,150	,,	12 June	4	Do. 4 p. c. Deb. Stk.	138–143	..	2 15 11
294,850	,,	,,	4½	Do. 4½ p. c. do.	153–158	..	2 16 11
908,000	,,	,,	6	Do. 6 p. c. do.	207–212	..	2 16 7
70,000	10	14 May	6	Hongkong & China, Limited	12–13	–½	4 12 4
3,800,000	Stck.	14 May	12	Imperial Continental	252–257	..	4 13 4
376,400	100	1 Aug.	4	Do. 4 p. c. Debs. Red.	100–103	..	3 17 8
473,600	Stck.	13 Aug.	3½	Do. 3½ p. c. Deb. Stk ,,	108–110*	..	3 3 8
£			p. c.	GAS COMPANIES.			£ s. d.
75,000	5	26 June	6	Malta & Mediterranean, Ltd.	6–6½	..	4 12 4
560,000	100	1 Apl.	5	Met. of Melbourne, 5p. c. Deb.	115–118	..	4 4 10
250,000	100	,,	4½	Do. 4½ p. c. Debs.	110–112	..	4 0 4
541,920	20	12 June	5	Monte Video, Limited	16½–17½	..	5 14 3
150,000	5	29 May	8	Oriental, Limited	8⅛–8⅜	..	4 11 5
135,000	5	,,	8	Do. New, £4 10s. paid	7⅞–7⅞	..	4 12 10
15,000	5	,,	8	Do. do. 1879, £1 paid	1¾–2	..	4 0 0
60,000	5	12 Mar.	7	Ottoman, Limited	5–5½	..	6 7 3
420,000	100	1 May	6	People's Gas } 1st Mtg. Bds.	105–110	..	5 9 1
500,000	100	1 June	6	of Chicago } 2nd Do.	102–107	..	5 12 1
250,000	10	27 Mar.	8	San Paulo, Limited	13½–14½	..	5 10 4
5,475,000	Stck.	13 Aug.	5/10	South Metrop., 4 p.c. Ord.	147–150*	..	3 9 4
820,000	,,	15 July	5	Do. 5 p. c. Deb. Stk.	173–176	..	2 16 10
60,000	Stck.	12 Mar.	11½	Tottenham & Edmonton, A	250–255	..	4 10 2
60,000	,,	,,	8½	Do. B	—	..	—
170,380	10	29 May	10	Tuscan, Limited.	13⅜–14½	..	6 18 0
149,900	10	1 July	5	Do. 5 p. c. Debs. Red.	98–100	..	5 0 0

WATER COMPANIES.

746,123	Stck.	26 June	10½	Chelsea, Ordinary	345–350	..	2 18 7
150,000	,,	,,	5	Do. 5 p. c. Pref.	175–180	..	2 15 6
160,000	,,	,,	4½	Do. 4½ p. c. Pref. Stk., 1875	160–164	..	2 14 10
175,785	,,	27 Mar.	4½	Do. 4½ p. c. Deb. Stock	165–170	..	2 12 11
1,719,514	Stck.	15 Apl.	7	East London, Ordinary	237–242	+2	2 17 11
654,740	,,	26 June	4½	Do. 4½ p. c. Deb. Stk.	165–170	..	2 12 11
100,000	,,	,,	3	Do. 3 p. c. Deb. Stk.	105–107	..	2 16 1
700,000	50	12 June	7½	Grand Junction, 10 p.c. max.	123–127	+1	2 19 0
280,000	Stck.	27 Mar.	4	Do. 4 p. c. Deb. Stk.	152–157	..	2 10 11
708,000	Stck.	13 Aug.	12	Kent	347–352*	+2	3 8 3
160,000	,,	,,	7	Do. New, 7 p. c. max.	220–225*	..	3 2 3
1,043,800	100	26 June	7½	Lambeth, 10 p. c. max.	268–273	–2	2 14 11
406,200	100	,,	7½	Do. 7½ p. c. max.	227–230	..	3 5 2
350,000	Stck.	27 Mar.	4	Do. 4 p. c. Deb. Stk.	152–157	..	2 10 11
500,000	100	13 Aug.	12/10	New River, New Shares	433–438*	..	2 18 11
1,000,000	Stck.	30 July	4	Do. 4 p. c. Deb. Stk.	157–160	..	2 10 0
902,300	Stck.	12 June	4	S'thwk & V'xhall, Ordinary	155–160	+1	2 10 0
126,500	100	,,	4	Do. Do. 7½ p. c. Max.	150–155	..	2 11 7
489,200	Stck.	,,	5	Do. Do. 5 p. c. Pref.	175–180	..	2 15 6
1,019,585	,,	15 Apl.	4	Do. 4 p. c. A Deb. Stk.	153–156	..	2 11 3
1,155,066	Stck.	12 June	10	West Middlesex	328–333	..	3 0 0
200,000	,,	,,	4½	Do. 4½ p. c. Deb. Stk.	165–170	..	2 12 11

*Ex div.

their accounts for the past year, and also disposed finally of the subject of the accident in the gas-works last November. The accounts showed that the income amounted to £5725. This was made up of £514 carried forward from the revenue account of the previous year, £4709 for gas sold, and £501 from the sale of residual products. The expenditure, on the other hand, amounted to £5436; leaving a balance of £289. But as the annuities payable on Aug. 15 amount to £464, the accounts showed a deficit on the year of £174. Accompanying the accounts was an estimate of the ordinary revenue and expenditure for the ensuing year. The income was expected to amount to £5130, consisting of £4510 from gas-rates, and £620 from residual products; and the expenditure was estimated at £4954, leaving a profit surplus of £175. The price of gas last year was 3s. 9d. per 1000 cubic feet; and the estimate was made up on the same rate. Mr. Craik, Convener of the Gas Committee, said that the accounts showed a deficit of £174, caused mainly in the tar and liquor account. He did not wonder very much at there being a deficit, after all the outlay upon repairs at the works. In reply to a question, the Manager (Mr. Forbes Waddell) said that the average price per ton of coal last year was about 16s. 10d.; and this year, it was under 15s. Mr. Christie, whose relish for a tussle with the Gas Manager is as keen as that of a dog after a hare, criticized the accounts and estimates adversely, particularly on the item of wages. But he received no support; and the accounts and estimates were adopted, with his dissent recorded. No one who is acquainted with the state of matters in Forfar during the past year need be surprised that a deficit resulted upon the working—indeed, the wonder is that it was not larger. There is still some outlay required to put the works into a condition approaching efficiency, which may affect the estimates; but, barring accidents, which are surely not appropriate subjects for estimate, Mr. Waddell should now have what he has not had since he went to Forfar—a chance to show what he can do.

With regard to the subject of the accident, little need now be said. What appeared to be developing into a large question, involving the liability of gas managers for the costs of Board of Trade inquiries, or might perhaps have resulted in the dismissal or resignation of the Manager, has ended without any finding either way. The feeling of the Corporation—apart from Mr. Christie—was that the report by Mr. A. Vernon Harcourt on the subject (consideration of which had been delayed to allow of the matter being discussed by the North British Association of Gas Managers) should be allowed to lie on the table, never to be taken up again. Mr. Adamson moved to this effect, and stated that he attended the North British meeting, at which Mr. Waddell was highly complimented for having come forward to read a paper on the accident. He also stated that the opinion of the members of the Association was that the cause of the occurrence was an accident, whether casual or intended none of them would say. Mr. Adamson's motion was unanimously adopted; and thus an unpleasant chapter in the gas industry has happily been closed.

Thomas Devaney, one of the men who were sent into penal servitude for life for complicity in the dynamite outrage in the Tradeston gas-works in Glasgow in January, 1883, was released from Portland prison on Monday, and returned to Glasgow the same day. He is liberated on ticket-of-leave, which requires him to report himself to the police at stated intervals. Devaney was a quay labourer—not a very likely position from which to assail this powerful Empire.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Aug.* 22.

Sulphate of Ammonia.—The market has been quiet during the week; but it closes with a rather better tone. This is occasioned by the larger demand for covering sales for August delivery. The buying has been done mainly in Scotland, where prices have been relatively low; but the supplies being ample, an advance has not been established. Consumers still hold aloof; but their stocks must now be getting at a low ebb, and when they come upon the market for their requirements, an improvement in values may reasonably be looked for. The quotations are £7 11s. 3d. to £7 12s. 6d. f.o.b. Leith; £7 13s. 9d. Hull; and £7 15s. to £7 16s. 3d. Liverpool. In the forward position, "bears" continue to offer freely; but buyers, having been wrong so often, are becoming more difficult to draw, even at the record prices quoted. For delivery over spring months, there are speculative sellers at about £8; but makers require more money.

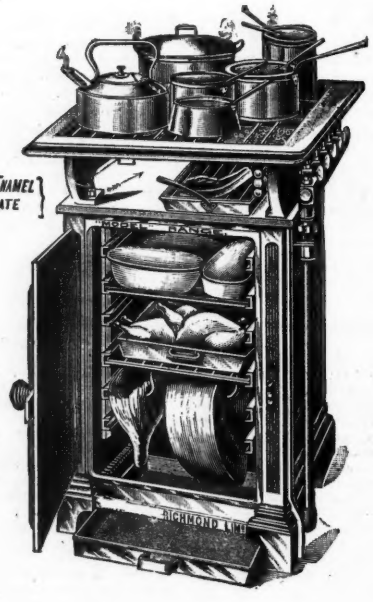
Nitrate of Soda is steady at 7s. 10½d., ordinary quality; and 8s. for refined.

LONDON, *Aug.* 22.

Tar Products.—Pitch does not so far participate in the better tone which marks some of the other leading products. No doubt the extremely low price of steam coal has something to do with the present flatness of this article; but it should not be forgotten that producers of dust coal must use pitch to make it a saleable article, and as the quantities of small coal, both on the Continent as well as in South Wales, is continually increasing, there should always be a market at a reasonable rate for any that may be produced. Benzols are steady; but most makers are well sold for the time being. There is more inquiry for carbolic acid, and a more hopeful feeling as to the future value. Cresylic acid, however, is not in such request as is usual at this period of the year. This is all the more remarkable, as the summer has been one of exceptional heat. Solvent naphtha is scarce and firm; and creosote and tar oils are all quotable at better rates. There is an improvement in the price of toluol, which is likely to be in much better request, as toluol colours are now again coming into fashion.

Quotations during the week are as follows: Tar, 19s. to 27s. Pitch, 31s. Benzols, 90's, prompt, 4s.; forward, 3s. 9d.; 50's, prompt, 3s.; forward, 2s. 9d. Toluol, 2s. 6d. Solvent naphtha, 1s. 5d. Crude, 30 per cent., naphtha, 1s. 1½d. Creosote, 2d.; liquid, 2½d. Heavy oils, 42s. 6d. Naphthalene, 65s.; salts, 32s. 6d. Cresylic acid, 1s. Carbolic acid, 60's, 1s. 11d. Anthracene, "A," 10½d.; "B," 8½d.

Sulphate of Ammonia does not improve. The position, however, is an abnormal one, and cannot possibly continue. With nitrate of soda at £8 5s., and sulphate of ammonia at £7 11s. 3d. to £7 15s., less 3½ per cent. at all ports, the position is inexplicable. There is more inquiry for forward delivery; but makers are withholding in the hope of better prices. Gas liquor is nominally quoted 6s. to 7s.



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COAL TRADE REPORTS.

From Our Own Correspondents.

Lancashire Coal Trade.—Practically all the contracts for gas coal of any moment are now settled for the ensuing season. The general basis of prices, as previously stated, has been under that which ruled on the 1895 contracts; the difference generally representing from 3d. to 6d. per ton. On this season's contracts, the average figures obtained for the better qualities of screened Wigan Arley have been about 6s. 7d. to 6s. 10d. per ton, at the pit mouth, as against about 7s. last year. The demand for all descriptions of fuel is just now only of the most limited dimensions; and collieries working more than three to four days per week are compelled to put into stock. At the pit, best Wigan Arley does not average above 9s. 6d. to 10s.; and Pemberton four-feet and seconds Arley, 8s. to 8s. 6d.

Northern Coal Trade.—The coal trade of this district has been again active; and there is now considerable inquiry for gas coals. Exports are maintained; and the home consumption is rising rapidly. For single cargoes, the price generally asked for best Durham gas coals is 6s. 6d. to 6s. 9d. per ton f.o.b.; and the collieries are beginning to work steadily away, though full time is not yet attained except in the case of some of the pits that do both an export and home trade, and that are favourably situated. Gas coke is steady; and as showing how some of the producing companies can keep down their stocks, it may be noted that the West Hartlepool Gas Company's report, just issued, shows that they commenced their recent financial year with only a small quantity of coke in stock, and that the year closed without a ton being so held. There is no general alteration in the price of gas coke this week.

Scotch Coal Trade.—A good volume of business is being done in all branches. Ell is in most demand; and prices are showing an upward tendency for all classes. Steam coal, though also in good request, has not perceptibly advanced. Splint is moving off freely; but the supply is quite equal to the demand, and rates remain unchanged. The prices quoted are: Main, 6s. per ton f.o.b. Glasgow; ell, 6s. 9d. to 7s.; and splint, 6s. 6d. to 6s. 9d. The shipments for the week amounted to 196,487 tons—an increase of 27,436 tons over the quantity in the preceding week, and of 21,114 tons in the corresponding period of last year. For the year to date, the total shipments have amounted to 4,677,549 tons—an increase over last year of 232,422 tons.

Sales of Shares.—Last Tuesday, 150 new ordinary shares (£2 10s.) in the York Town and Blackwater Gas Company, Limited, were sold by Mr. F. W. Baker at £3 15s. to £3 17s. 6d. each. On Friday, 44 £10 shares in the Chatham Water-Works Company were sold by auction, when four realized £15 12s. each, and the rest £15 11s. apiece.

The Public Lighting of Lowestoft.—A special meeting of the Lowestoft Town Council was held last Tuesday, to consider the report of the General Purposes Committee on the question of public lighting, which had been referred back on two occasions for further report. The Committee recommended the acceptance of a tender based on the old terms, which made the gas work out at 3s. 3d. per 1000 cubic feet. This was agreed to; the question of extending the system of incandescent gas lighting in the town being abandoned on the plea that 12s. extra per lamp, for this light, equivalent to a rate of 1d. in the pound, was prohibitive. Before the question was discussed, Alderman Capps asked if shareholders in the Gas Company were eligible to vote. The Town Clerk (Mr. R. B. Nicholson) replied in the negative; and, in answer to a further inquiry, added that they were also prohibited from speaking.

Projected Extensions at the Malvern Gas-Works.—Colonel A. G. Durnford, one of the Local Government Board Inspectors, held an inquiry at the office of the Malvern Urban District Council last Wednesday respecting an application from the Malvern District Council for sanction to borrow £6000 for the extension of the gas-works. There was no opposition. From the statement of the Chairman of the Gas Committee, it appeared that the storage capacity at the works was 350,000 cubic feet, and that in winter the largest consumption of gas in the district was 250,000 cubic feet. A number of new lamps had been erected in the roads at the Wyche, and a gas supply would have to be provided for Malvern Wells and other parts. Since 1894, the increase in the demand for gas had been at the rate of 18 per cent.; and in winter the present supply would not be equal to the demand. The Council had decided to erect an additional gasholder to contain 500,000 cubic feet. Land had been purchased at a cost of £260 (including compensation). Everything had been done to press forward the work to get a supply for Malvern Wells in the coming winter. The Inspector visited the several parts of the district concerned, and will report in due course.

The Aldeburgh Town Council and the Gas and Water Works.—Mr. J. Mansergh, M.Inst.C.E., has been instructed by the Aldeburgh Town Council to make a report upon the local gas and water undertakings, with a view to their being acquired by the Corporation.

Oil Lighting by a Gas Company.—At the meeting of the Brownhills District Council last Wednesday, the tender of the Gas Company to supply oil-lamps at the rate of £2 7s. 6d. per lamp per annum and £2 5s. for gas-lamps, was accepted; and a contract was entered into for 30 lamps.

The New Gas-Works for Southborough.—The Southborough District Council have accepted the tender of Messrs. E. Punnett and Sons, of Tonbridge, for the construction of a gasholder tank at the new gas-works; the price quoted being £774. This was the lowest tender the highest being £1145.

Remodelling of the Desborough Gas-Works.—The Desborough Gas Company have decided to entirely remodel their works. The contract has just been placed in the hands of Messrs. R. Dempster and Sons, Limited, of Elland, who have recently completed the erection of one of Mr. W. R. Chester's generator settings at these works.

An Incandescent Gas-Light Insurance Company.—According to the Berlin Correspondent of "Industries and Iron," a novel sort of company has lately been formed in Hamburg, with the title of the Gas Glühlicht Versicherungs Gesellschaft. The object is to carry on an incandescent gas-light insurance business—that is to say, for a monthly premium of about 3d., the Company will undertake to renew any damaged or broken mantle or burner.

Projected Extension of the Frith Hill and Godalming Water-Works.—At a special meeting of the Frith Hill, Godalming, and Farncombe Water Company, held on the 14th inst., the Directors were authorized to raise additional capital for carrying out some extensions of the works. A duplicate set of Worthington engines, pumps, and boilers is to be put in hand, at a cost of £4000: and a new reservoir is to be constructed which, with the engine and boiler house and the site, is estimated to come to £10,000.

Leicester Water Supply.—The Mayor of Leicester announced last Tuesday that the stock of water in the Corporation reservoirs had been reduced to 271 million gallons; showing a deficiency of 613 million gallons, as compared with 342 millions at the corresponding date of last year. During the week ending the 15th inst., the consumption was 17,795,340 gallons, or 2,542,190 gallons per day. Of this quantity, 6,686,273 gallons had been drawn from auxiliary sources, such as deep wells, &c., and 11,109,067 gallons from stock. The rainfall for the year had been 10·60 and 10·38 inches, as compared with 14·53 and 14·20 inches in the previous year. During the year, the water consumers had increased by 4000, and now numbered 215,745. Thanks to the development of the auxiliary supplies, and the economy of consumption, the Mayor and Water Committee now hope to be able to tide over the difficulty which has confronted them owing to the exceptional and protracted drought.

Ottoman Gas Company, Limited.—The Directors of this Company report that the gas-rental for the half year to June amounted to £8630, comparing with £8738 for the corresponding six months of 1895; and the net profit to £3227. The profit and loss account is in credit to the amount of £4115, which enables the Directors to recommend a dividend at the rate of 7 per cent. per annum—£2625 in all—and the placing of £1000 to the reserve fund, which will then amount to £10,000. In addition to the gas-rental mentioned above, £1481 was received for residuals during the half year; and £296 from meter rents and as profit on fittings supplied. Coal cost £2406; wages and materials and lamp-lighting, £1396; salaries and office expenses at Smyrna and in London, £1304; and loss on exchange and bad debts, £760. A sum of £863 was set aside for depreciation; and other charges absorbed £282. The balance of the revenue account therefore is £3397, out of which the Ottoman Government receive £170—being 5 per cent. on the half-year's profits.

The Water Supply in East London.—After the usual meeting of the Directors of the East London Water Company last Thursday, it was stated that the Directors had not found it possible to make any arrangements in the direction of increasing the supply to the consumers. The curtailed service of six hours a day, to which reference has already been made, would be maintained, for the present at any rate, as, with the Lea in its existing condition, the Company were unable to get enough water to add to the amount supplied. They were pumping millions of gallons of water into the district covered by their service, though there did not seem to be so much waste as at the beginning of the drought. Each person was receiving 30 gallons per day, and with the utensils supplied by the Company for the purpose of house storage, matters were going on fairly satisfactorily. A meeting of ratepayers was held on the same day at Poplar, when a resolution was carried protesting against the action of the Company in curtailing the quantity of water and charging the ratepayers for a full supply.

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Four 8-ft. square PURIFIERS, complete with Connections and Centre-Valve, 8-in. diameter.
One 100,000 cubic feet per day LIVESEY WASHER, with Connections.
Four Sets of MOUNTINGS for Six 15-in. Round Retorts, including Hydraulic Mains.
One 4000 cubic feet per hour STATION METER, with new Drum.
Two small SCRUBBERS, suitable for Tanks.
Two 8-in. FOUR-WAY BYE-PASS VALVES.
One 10-in. SIX-WAY BYE-PASS VALVE.
Apply to HARRY WIMHURST, Gas-Works, SLEAFORD.

RADCLIFFE AND PILKINGTON GAS COMPANY.

TO TAR DISTILLERS.

THE Directors of this Company invite TENDERS for the purchase of 700 Tons of the surplus TAR to be produced at their Works in Radcliffe during the Twelve Months commencing the 1st day of October next.
Particulars may be obtained from the undersigned, to whom endorsed Tenders must be delivered not later than Tuesday, the 1st of September next,
JAS. BRADDOCK,
Manager and Secretary.
Gas-Works, Radcliffe,
Aug. 20, 1896.

CORPORATION OF LEICESTER.

SULPHURIC ACID.

THE Gas and Electric Lighting Com-mittee of the above Corporation are prepared to receive TENDERS for the supply of SULPHURIC ACID, made either from Native Sicilian Brimstone, or Recovered Sulphur, or Pyrites.
Specific gravity in each case to be stated. The price to include free delivery by rail into elevated Tanks, 27 feet high, at the Chemical Works, Aylestone Road.
Probable quantity about 1600 Tons, to be delivered as required during the ensuing Twelve months.
Tenders, addressed to Alderman Lennard, Chairman, and endorsed "Tender for Acid," to be delivered at these Offices, not later than Eleven o'clock a.m., on Saturday, Sept. 12.
The Committee do not bind themselves to accept the lowest or any tender.
ALFRED COLSON, M.Inst.C.E.,
Engineer and Manager.
Offices: Millstone Lane,
Leicester, Aug. 20, 1896.

SOUTHBOROUGH URBAN DISTRICT COUNCIL.

NEW GAS-WORKS.

THE Urban District Council invite TENDERS for the construction of a TELESCOPIC GASHOLDER to contain about 75,000 cubic feet, at the New Gas-Works, Southborough.
Drawings may be seen, and copies of Specification obtained, at the Office of the Engineer, Mr. Corbet Woodall, Palace Chambers, Bridge Street, Westminster, S.W., or at the Urban District Council Offices, Southborough.
One guinea will be charged for copies of Specification, which will be returned upon receipt of a *bond-fide* tender.
Tenders, marked "Tender for Gasholder," and addressed to the undersigned, are to be delivered at the Council Offices, Southborough, not later than Ten a.m., on Wednesday, the 16th day of September, 1896.
The lowest or any tender will not necessarily be accepted.
By order of the Urban District Council,
PHILIP HANMER,
Clerk.
Council Offices, Southborough,
Aug. 20, 1896.

CITY OF LEEDS.
(GAS DEPARTMENT.)

THE Gas Committee of the Leeds City Council are prepared to receive TENDERS for the erection complete of Four Benches of INCLINED RETORTS at the Meadow Lane Gas-Works, also for the STRUCTURAL IRONWORK for the same.
Plans can be seen, and Specification and Bill of Quantities obtained on application to the undersigned.
Tenders, endorsed "Tender for Inclined Retorts," and addressed to the Chairman of the Gas Committee, Municipal Buildings, Leeds, will be received not later than Tuesday, the 8th of September.
The Committee do not bind themselves to accept the lowest or any tender.
R. H. TOWNSLEY,
General Superintendent.
Municipal Offices, Calverley Street,
Leeds, Aug. 18, 1896.

OTTOMAN GAS COMPANY, LIMITED.

NOTICE is Hereby Given, that the ORDINARY HALF-YEARLY GENERAL MEETING of the Shareholders of this Company will be held at 9, Queen Street Place, Cannon Street, E.C., on Tuesday, Sept. 1, 1896, at One o'clock precisely, to receive the Report of the Directors and Statement of Accounts for the Half Year ended June 30 last, to declare a Dividend, and for General Purposes.
The TRANSFER BOOKS WILL BE CLOSED from Aug. 25 to Sept. 1, both days inclusive.
By order of the Board,
THOMAS GUYATT,
Secretary.
9, Queen Street Place, Cannon Street,
London, E.C., Aug. 11, 1896.

BRIGHTON & HOVE GENERAL GAS COMPANY.

TO THE PROPRIETORS.

NOTICE is Hereby Given, that the ORDINARY HALF-YEARLY GENERAL MEETING of the Proprietors of this Company will be held at the Company's Offices, No. 5, Great Winchester Street, London, on Friday, the 11th of September, 1896, at Two o'clock in the Afternoon precisely, to receive the Report of the Directors and the Accounts of the Company for the Half Year ended the 30th of June, 1896; to declare Dividends; to elect Auditors; and for other purposes.
The TRANSFER BOOKS of the Company WILL BE CLOSED from the 29th of August to the 11th of September, both days inclusive.
By order,
ERNEST L. BURTON, Secretary.
5, Great Winchester Street,
London, E.C., Aug. 24, 1896.

TOTTENHAM AND EDMONTON GASLIGHT AND COKE COMPANY.

NOTICE is Hereby Given, that the ANNUAL ORDINARY GENERAL MEETING of the Proprietors of this Company will be held at the Offices, Willoughby Lane, Tottenham, on Saturday, the 29th day of August inst., at Half-past Three o'clock in the afternoon precisely, to receive the Report of the Directors and Statement of Accounts for the Half Year ended the 30th of June, 1896, to declare Dividends for the same period, and for the election of two Directors and an Auditor for the ensuing Year; also to consider the NOTICE OF MOTION given at the Half-Yearly Meeting held on the 29th of February last, as follows: "That, at the next General Meeting of Proprietors, the Salary of the Secretary be considered, with a view to its increase;" and for transacting General Business.
The TRANSFER BOOKS WILL BE CLOSED for the Consolidated Stocks from the 14th to the 29th of August inst., both days inclusive.
By order of the Board,
JAMES RANDALL,
Secretary.
Offices of the Company:
Willoughby Lane, Tottenham,
Aug. 7, 1896.

ISSUE OF STOCKS AND SHARES BY AUCTION UNDER PARLIAMENTARY POWERS.

MR. ALFRED RICHARDS undertakes the issuing by Auction of GAS AND WATER SHARES under Parliamentary Powers.
He also holds MONTHLY SALES of GAS AND WATER SHARES at the Auction Mart, Tokenhouse Yard, E.C.
Terms for the issuing of Capital, and also for offering to auction Gas and Water Shares, and all Particulars relating thereto, may be had of Mr. Alfred Richards.
Offices: 18, FINSBURY CIRCUS, E.C.

Price 6s., Cloth Bound,

THE CHEMISTRY OF ILLUMINATING GAS.

By N. H. HUMPHRYS, Assoc. M.Inst.C.E., F.C.S.

This work contains chapters on: The Relative Cost of Light from Gas, Oil, and Candles; Products of Combustion; The Sulphur Question; The Composition of Illuminating Gas; Water Gas; Various Gas-Making Processes; Oil Gas; Properties of Fluid Hydrocarbons; Tar for Gas-Making; Destructive Distillation; Condensation; and Purification.

WALTER KING, 11, Bolt Court, FLEET STREET, E.C.

NOTICE.

The attention of the METEOR INCANDESCENT LIGHTING COMPANY, LIMITED, having been again called to the Advertisements inserted in various papers by the Incandescent Gas-Light Company, Limited, of Palmer Street, Westminster, to the effect that the "Meteor" Incandescent Gas-Lights are an Infringement of their Patents, and that they will bring Actions for Infringement against all persons found dealing in any manner with such Lights, the METEOR INCANDESCENT LIGHTING COMPANY, LIMITED, HEREBY GIVE NOTICE that they are advised that the "Meteor" Incandescent Lights in no way infringe any of the Patents of the Incandescent Gas-Light Company, Limited, that an action has been commenced to restrain such threats, and that they are PREPARED TO FULLY INDEMNIFY ALL PURCHASERS, DEALERS, AGENTS, and USERS of their Lights against any Legal Proceedings on the part of the Incandescent Gas-Light Company, Limited.

WILSON, BRISTOWS, & CARPMAEL,
1, Copthall Buildings, London, E.C.,
Solicitors to the Meteor Incandescent Lighting Company, Limited, of 35, New Broad Street, London, E.C.
Nov. 30, 1895.

ROBERT MARSHALL,
CANNEL COAL MERCHANT,
97, WELLINGTON STREET, GLASGOW.

Prices and Analysis of all the Scotch Cannels on Application.

THOMAS TURTON AND SONS, LIMITED,

SHEAF WORKS, SHEFFIELD,
MANUFACTURERS OF
FILES OF BEST QUALITY
FOR ENGINEERS.
STEEL OF ALL DESCRIPTIONS.
SCREW STOCKS, TAPS AND DIES,
SPANNERS, RATCHET BRACES, LIFTING JACKS,
ANVILS, VICES,
AND ENGINEERS' TOOLS GENERALLY.
LONDON OFFICE:
90, CANNON STREET, E.C.

THORNLEY GAS COALS

WORKED BY THE
WEARDALE IRON & COAL Co., Ld.
OUT OF THEIR
THORNLEY AND WHEATLEY HILL COLLIERIES.

Analysis made by
Messrs. J. & H. S. PATTINSON, *May 28, 1895.*

Yield of Gas per Ton . .	10,500 Cub. Ft.
Illuminating Power . .	16·9 Candles.
Coke (of good quality) . .	67·5 per Cent.
Sulphur	0·58 ,,
Ash	2·73 ,,

For Price, &c., apply to the
WEARDALE IRON & COAL Co., Ld.
QUAYSIDE, NEWCASTLE-ON-TYNE.

THE INCANDESCENT GAS-LIGHT COMPANY, LIMITED,

— *v* —

"DE MARE" COMPANY.

THE INCANDESCENT GAS-LIGHT COMPANY, LIMITED.

— *v.* —

"SUNLIGHT" COMPANY.

THE INCANDESCENT GAS-LIGHT COMPANY, LIMITED, HEREBY GIVE NOTICE, as follows:—

VALIDITY. The Company's Patent has been declared VALID ON ALL POINTS after a Fifteen-Day Trial.

NATURE OF INVENTION. The Invention was described by Mr. Justice Wills as a "PIONEER INVENTION."

SCOPE OF PATENT. The Patent HAS BEEN GIVEN A WIDE CONSTRUCTION; and it was held that the protection given by it was not confined to Mantles manufactured according to the particular prescriptions set out in the Specification.

SHAPE OF MANTLE. The Judge held that a Mantle, even if made in a different form or shape (such as the "De Mare" Fringe or Plume), IS STILL AN INFRINGEMENT of the "Welsbach" Patent.

"DE MARE" JUDGMENT. Judgment for an INJUNCTION, WITH FULL COSTS, has been given against the "De Mare" Incandescent Gas-Light System.

"SUNLIGHT" JUDGMENT. Judgment was given AGAINST the "Sunlight" Incandescent Gas-Lamp Company, Limited, on the question of the VALIDITY OF THE PLAINTIFFS' PATENT.

"SUNLIGHT" MANTLES. Last about 100 hours.

"WELSBACH" MANTLES. Last about 1000 hours.

"Sunlight" Mantles BURN DOUBLE THE GAS to produce the same candle power as the Incandescent Gas-Light Company's Mantles.

Users of "Sunlight" Mantles are applying to the Incandescent Gas-Light Company to REPLACE THEM BY THEIR OWN MANTLES.

WARNING. Users of the Incandescent Gas-Light Company's Mantles upon "Sunlight" Burners ARE INFRINGERS OF THE COMPANY'S PATENT, AND WILL BE AT ONCE PROCEEDED AGAINST.

COSTS. Certificates of the Validity of the Company's Patent have been granted both by Mr. Justice Romer and Mr. Justice Wills entitling the Company to Solicitor and Client Costs, which will, IN ALL CASES, BE RIGOROUSLY ENFORCED.

INFRINGERS. The Incandescent Gas-Light Company WILL TAKE PROCEEDINGS AGAINST ALL PERSONS INFRINGING THEIR PATENT WHETHER

MAKERS,
WHOLESALE DEALERS,
RETAILERS,
or
USERS.

Users of the Company's Mantles upon Burners not sold by the Company ARE INFRINGERS.

"LIMITED LICENSE" WARNING. Judgments have already been obtained against such users from Mr. Justice Chitty, Mr. Justice Stirling, Mr. Justice Kekewich, and Mr. Justice North.

FAITHFULL & OWEN,
11, Victoria Street,
Westminster.

Solicitors to the Incandescent Gas-Light Company, Limited.

April, 1896.

CUTLERS PATENT TUBULAR GAS CONDENSER SUITABLE FOR GASWORKS OF ALL SIZES, AND FOR ANY CLIMATE OVER 100 ERECTED

TANKS ROOFS

MAKERS OF GASHOLDERS OF EVERY SIZE AND TYPE

HUNT'S PATENT WASHER. IS THE ONLY APPARATUS NECESSARY BETWEEN THE CONDENSER & PURIFIERS. IT REQUIRES NO MOTIVE POWER

TELEGRAMS "RETORTUS" LONDON

NATIONAL TELEPHONE 5059.

S. CUTLER & SONS, MILLWALL LONDON

A SPECIALTY STEEL TANKS FOR GASHOLDERS AND OIL STORAGE.

FOREIGN AGENTS

IMPROVED SYSTEM OF CARBURETTED WATER-GAS PLANT PARTICULARS ON APPLICATION.

COLONIAL AGENTS

CUTLER'S FREEZING PREVENTER IS THE BEST APPLIANCE FOR PREVENTING FORMATION OF ICE IN GASHOLDER CUPS. IT IS IN USE AT MANY IMPORTANT WORKS IN ENGLAND, GERMANY, AUSTRIA, AND AMERICA

ELECTRIC FITTINGS

DYNAMOS MOTORS.

HEBBURN MAIN GAS COALS.

Yield of Gas per ton . . . . . 10,500 cub. ft.
Illuminating Power . . . . . 16·4 candles.
Coke . . . . . 68 per cent.

For Prices, f.o.b. Ship or Delivered by Rail, apply to
THE WALLSEND & HEBBURN COAL COMPANY, LTD.
8 Lombard Street,
NEWCASTLE-ON-TYNE.
W. RICHARDSON, Fitter.

COKE-BREAKERS,

PRICES REDUCED.

(THOMAS & SOMERVILLE'S PATENT)

New Design, with two Cutting Rollers, making less Breeze than their old pattern.

GEORGE WALLER & CO.,
165, QUEEN VICTORIA STREET, E.C.,
And at STROUD, GLOUCESTERSHIRE.

HOLMSIDE GAS COALS.

PRESENT DAILY PRODUCE OVER 4000 TONS.

LATEST ANALYSIS—By CHARLES PHILLIPS, Gas Examiner to Rotherham Corporation.

Yield of Gas Per Ton. . 11,205 Cubic Feet.
Illuminating Power, 16 7/10 Stand. Sperm. Candl.
Coke (of good & pure quality) 13¾ Cwt. Per Ton.
Sulphur . . . . A little over 1 Per Cent.
Ash . . . . . Under 1 Per Cent.
Tar . . . . . 163 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor 103 Lbs. (Avoir.) Per Ton.

HOLMSIDE GAS COALS are supplied to the largest Gas Companies in England and on the European Continent; London alone consuming about half the produce.

SOUTH MOOR PELTON GAS COALS.

PRESENT DAILY PRODUCE AVAILABLE 2500 TONS.

RESULTS OF DIFFERENT ANALYSES:—

Yield of Gas Per Ton. . 10,500 Cubic Feet
Illuminating Power . 17 Stand. Sperm Candl
Coke (of excellent quality) . 13½ Cwt. Per Ton.
Sulphur . . . . . 1·13 Per Cent.
Ash. . . . . 1·34 Per Cent.
Tar. . . . . 180 Lbs. (Avoir.) Per Ton.
Ammoniacal Liquor 94½ Lbs. (Avoir.) Per Ton.

The HOLMSIDE and SOUTH MOOR COALFIELD possesses *a very great quantity of the best Coal;* and, whilst other Coal-Fields are becoming exhausted, this one is only being opened out, so that *the quality* of both the HOLMSIDE COALS, and the SOUTH MOOR COALS *may be relied upon for all practical purposes.*

These Coals may be bought through the Principal Merchants in England, or direct from

MR. MARK ARCHER,
HOLMSIDE AND SOUTH MOOR OFFICES,
NEWCASTLE-UPON-TYNE.

NEWBATTLE CANNEL.

Highest Results in Gas, & Excellent Coke.

QUOTATIONS ON APPLICATION TO

THE LOTHIAN COAL COMPANY,
LIMITED,
NEWBATTLE COLLIERIES,
DALKEITH, N.B.

LONDONDERRY GAS COALS

FROM THE

MARQUIS OF LONDONDERRY'S COLLIERIES,
COUNTY OF DURHAM.

Available output up to 5000 tons per day.
Yield of Gas 11,000 cubic feet per ton of Coal as per analysis by
Mr. John Pattinson, F.C.S., F.I.S.

FOR PRICES AND PARTICULARS, APPLY TO

S. J. DITCHFIELD,
SEAHAM HARBOUR, COUNTY OF DURHAM.

BOLDON GAS COALS.

Worked by THE HARTON COAL CO., LTD.
Output about 3000 tons per day.

ANALYSIS—

Yield of Gas per ton . .	10,500	Cubic Feet.
Illuminating Power . .	16·9	Candles.
Coke	66·7	Coke.
Sulphur	0·86	Sulphur.
Ash	2·04	Ash.

Boldon Gas Coals are supplied under contract to

The Gaslight and Coke Company, South Metropolitan Gas Company, Commercial Gas Company, Imperial Continental Gas Association, European Gas Company, L'Union des Gaz (the Continental Union Gas Company), Crystal Palace District Gas Company, Danish Gas Company, Bombay Gas Company, San Paulo Gas Company, Alliance and Dublin Consumers' Gas Company, Ipswich Gaslight Company, Newcastle Gas Company, Sunderland Gas Company, South Shields Gas Company, and to many other Companies at Home and Abroad.

For Prices, &c., apply to the

HARTON COAL COMPANY,
LIMITED,
Newcastle-on-Tyne.
W. H. PARKINSON,
FITTER.

JAMES OAKES & Co.,

ALFRETON IRON-WORKS, DERBYSHIRE,
AND
Wenlock Iron Wharf, 21 & 22, Wharf Road,
CITY ROAD, LONDON, N.,

Manufacture and keep in Stock at their Works (also large stock in London)

PIPES and CONNECTIONS, 1¼ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.

NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with bolts, nuts and covers, and rendering leakage impossible.

Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887, for

CANNEL & COAL.

TYNE

BOGHEAD CANNEL.

Yield of Gas per ton . . . . . 13,155 cub. ft.
Illuminating Power . . . . . 38·22 candles
Coke per ton . . . . . 1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton . . . . . 10,500 cub.
Illuminating Power . . . . . 17·8 candles.
Coke . . . . . 70 per cent.

SOUTH PELAW MAIN GAS COAL.

Yield of Gas per ton . . . . . 10,500 cub.
Illuminating Power . . . . . 16·3 candles.
Coke . . . . . 73·1 per cent.

For Prices and complete Analysis, apply to

THOS. W. DANCE & SONS,
COAL OWNERS, NEWCASTLE-ON-TYNE;
OR
E. FOSTER & CO.,
12, JOHN STREET, ADELPHI, LONDON, W.C.

INCANDESCENT STREET LIGHTING, &c.

IMPORTANT TO GAS COMPANIES, LIGHTING AUTHORITIES, RAILWAY COMPANIES, &c

Great Saving in Mantles, Chimneys, Attendance, &c.

ECONOMICAL, EFFICIENT, SATISFACTORY.

APPLICABLE TO EXISTING LAMPS.

MINIMUM OF SKILLED LABOUR REQUIRED IN FIXING.

Successful results guaranteed in all Situations.

FULL PARTICULARS ON APPLICATION TO

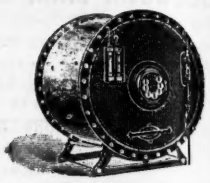
THE ANTI-VIBRATION INCANDESCENT LIGHTING COMPANY, LIMITED,
12 & 14, WESTGATE ARCADE, BRADFORD, YORKS., ENGLAND.
Telegraphic Address: "CANDESCENT, BRADFORD."

JAMES MILNE & SON, LTD.,

GAS ENGINEERS,

MILTON HOUSE WORKS, EDINBURGH.

LONDON. — GLASGOW. — LEEDS.

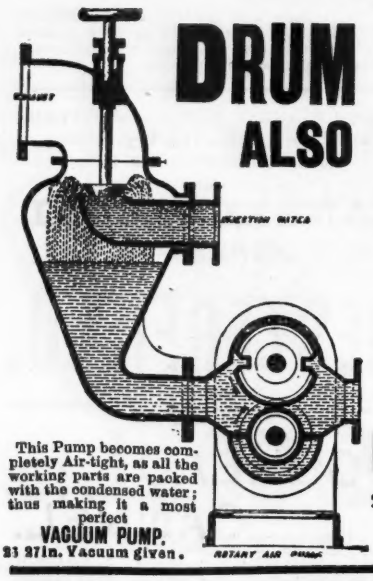


"The Force of the Piston Pump with the Capacity of the Centrifugal combined."

JOHNSON'S PATENT

DRUM PUMP AND EXHAUSTER

ALSO VACUUM PUMP AND CONDENSER.



This Pump becomes completely Air-tight, as all the working parts are packed with the condensed water; thus making it a most perfect

VACUUM PUMP.

21 27in. Vacuum given.

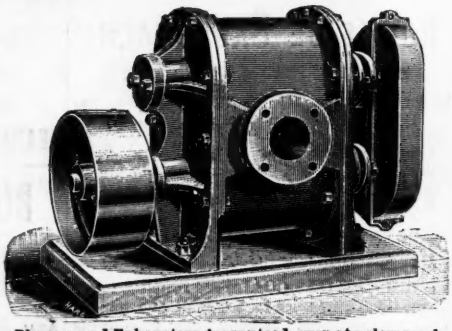
No Priming, Valves, or Frictional Working Parts.

The Pump of the future for quickly and economically moving large Bodies of Water, Semi-fluid, &c.

DRUM ENGINEERING Co.

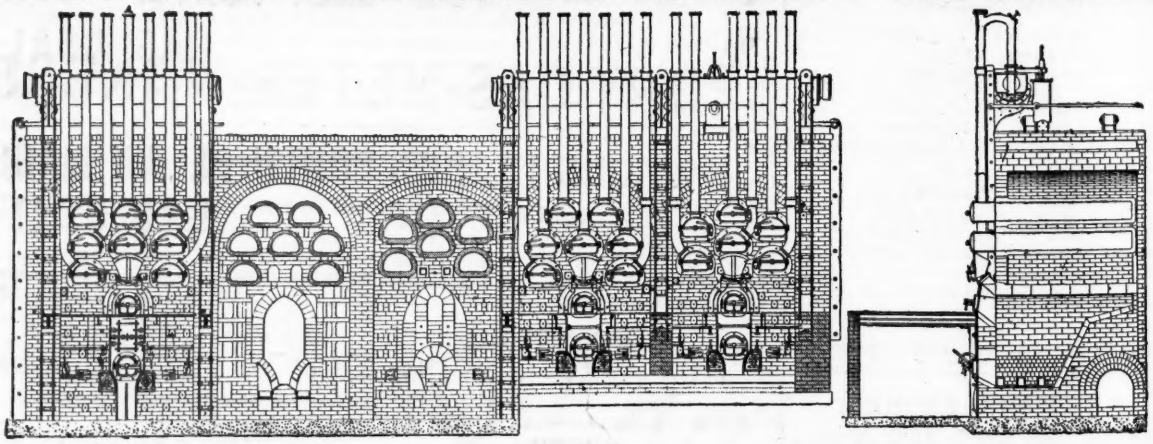
27, CHARLES ST.,

BRADFORD.



Blowers and Exhausters guaranteed, even at a slow speed, to give a working pressure of 3 lbs. and upwards, and this without losing power by creating frictional Heat.

HISLOP'S PATENT REGENERATIVE SETTINGS OF GAS-RETORTS.



THESE SETTINGS ARE POSITIVELY UNRIVALLED IN PRODUCTIVE CAPACITY, DURABILITY, AND SIMPLICITY OF MANAGEMENT. RETORTS OF ORDINARY DIMENSIONS CARBONIZING FROM 18 TO 24 CWT. OF ENGLISH AND 21 TO 26 CWT. OF SCOTCH COAL PER 24 HOURS, DEPENDING UPON THE NATURE OF THE COAL, AND PRODUCING UP TO FULLY 13,000 CUBIC FEET PER MOUTHPIECE IN THE SAME TIME, AND WITH THE SMALLEST EXPENDITURE OF FUEL ATTAINABLE, AND RETURNING IN PROFIT THE ENTIRE COST OF ERECTION WITHIN TWELVE TO EIGHTEEN MONTHS; AND THUS REDUCING TO INSIGNIFICANCE THE INCREASED COST OF THESE SETTINGS OVER THE COMMON OR GENERATOR FURNACE SYSTEMS.

THESE SETTINGS ARE EXTENSIVELY ADOPTED, AND ARE ERECTED UPON THE SHALLOW AND STAGE FLOOR PLANS. THEY ARE ADAPTED TO ANY EXISTING ARRANGEMENTS, AND PERFECT SATISFACTION GUARANTEED. THE COMPOSITION OF FIRE-RESISTING AND OTHER SPECIAL FIRE-CLAY MATERIALS FURNISHED IS OF THE HIGHEST ORDER; AND THE SYSTEM AS A WHOLE, AS NOW PERFECTED, IS THE RESULT OF LONG EXPERIENCE AND CAREFUL STUDY OF THE PRINCIPLES OF GASEOUS FIRING.

Drawings and Tenders are furnished for the complete erection of Benches, including Retort and Bench Mounting of the most modern and approved description; or existing Ovens fitted up with the Patentee's arrangements.

Full Particulars may be had on application to the Patentee's Agents: **Messrs. JONAS DRAKE AND SON**, Retort Setters and General Carbonizing Engineers, Ovenden, Halifax, Yorkshire, Sole Agents for England, Wales, and Foreign Countries; **C. M. HAMILTON**, Retort Setter and Contractor, 5, Stuart Street, Shawlands, Glasgow, Agent for Scotland and Ireland; and to the Principal Agent, **R. F. HISLOP** (Son of Patentee), General Constructing and Carbonizing Engineer, Gas-Works, Paisley, N.B.

HISLOP'S PATENT HYDRAULIC MAIN SEAL-REGULATING AND TAR-EXTRACTING VALVE is a *Sine qua non.*

TO THE SATISFACTORY WORKING OF THE HYDRAULIC MAIN UNDER THE REGENERATIVE AS WELL AS OTHER SYSTEMS OF RETORTS. BEING LARGELY ADOPTED AND AFFORDING THE HIGHEST SATISFACTION.

The Patentee's SELF-SEALING CAPS FOR THE TOP OF ASCENSION-PIPES, and his "SPECIAL" FLUE PORT BOXES, are most important additions to his Carbonizing Plant.

SPENT LIMES NO LONGER WASTE PRODUCTS.

Under G. R. HISLOP'S Patents, all Spent Limes are effectively recovered at from one-third to one-half the cost of New Lime.

Further Information and Pamphlets from Principal Agent.

TROTTER, HAINES, & CORBETT,
Brettell's Estate
FIRE-CLAY & BRICK WORKS,
STOURBRIDGE.

Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.
Proprietors of
BEST GLASSHOUSE POT & CRUCIBLE CLAY.
Shipments Promptly and Carefully Executed.

London Office: R. Cull, 84, Old Broad St., E.C.

HUNTER'S
OXIDE OF IRON.
James Hunter, Miner, and Shipper of NATURAL IRISH BOG ORE.
This Estate yields the finest and most uniform quality in Ireland; and the quality is guaranteed.
Samples and Prices on application.
5, PRINCES STREET, PORT GLASGOW.
Telegrams: "Hunter, Port Glasgow."
Established 1872.

UNEQUALLED.
Gas Companies are solicited to try Samples of the
MIRFIELD
BLACK BED GAS COAL.
Prices and Analysis on application.
MIRFIELD (GAS-COAL) COLLIERY COMPY.
RAVENSTHORPE, near DEWSBURY.

HEATHCOTE GAS COAL.

RICH IN ILLUMINATING POWER AND YIELD OF GAS.
ABOVE THE AVERAGE IN WEIGHT AND QUALITY OF COKE.
MAINTAINS A HIGH STANDARD IN RESIDUALS.

THE GRASSMOOR Co., Ld., CHESTERFIELD.

D. HULETT & CO., Ltd.

55 & 56, High Holborn, London.

GAS SERVICE CLEANSERS.
LAMP TORCHES.
DRY GAS-METER MAKERS.
WROUGHT-IRON TUBES & FITTINGS.
STREET LAMPS & POSTS.
PRICE LISTS ON APPLICATION.

GASEOUS FIRING A SPECIALTY.

Telegraphic Address:
"DRAKESON, HALIFAX."

GAS ENGINEERS.
RETORT SETTERS.
IRONFOUNDERS.

SOLE MAKERS OF
"MITTON'S"
PATENT SELF
-SEALING-
RETORT-LID.

JOMS DRAKE & SON

-SOLE AGENTS-
— For —
"HISLOP'S"
PATENT REGENERATIVE
— FURNACES. —
FOR ENGLAND, WALES & ABROAD.
OVENDEN, HALIFAX.

Telephone No. 43.
HALIFAX EXCHANGE.

CONTRACTORS.
FURNACE BUILDERS.
&c. &c.

- SOLE MAKERS OF -
"SETTLE'S"
PATENT COMBINED
SEAL-REGULATING
FLUSH-VALVE.

LONDON OFFICE:
60, QUEEN VICTORIA ST., E.C.

JOHN BROWN & CO., LTD., SHEFFIELD.

Proprietors of

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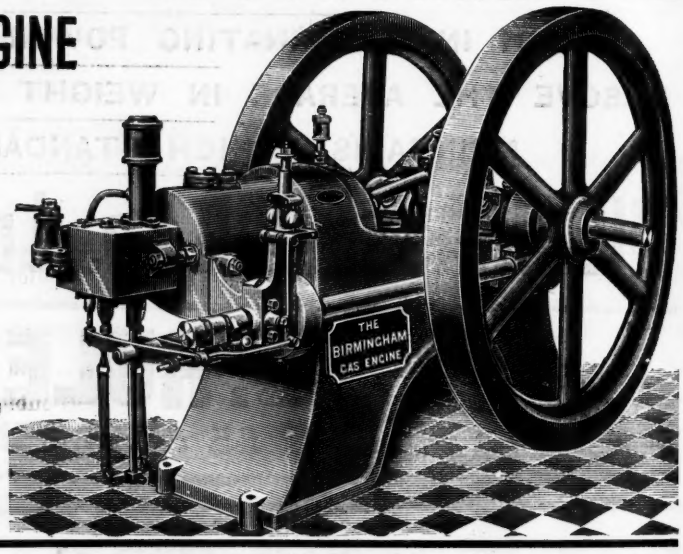

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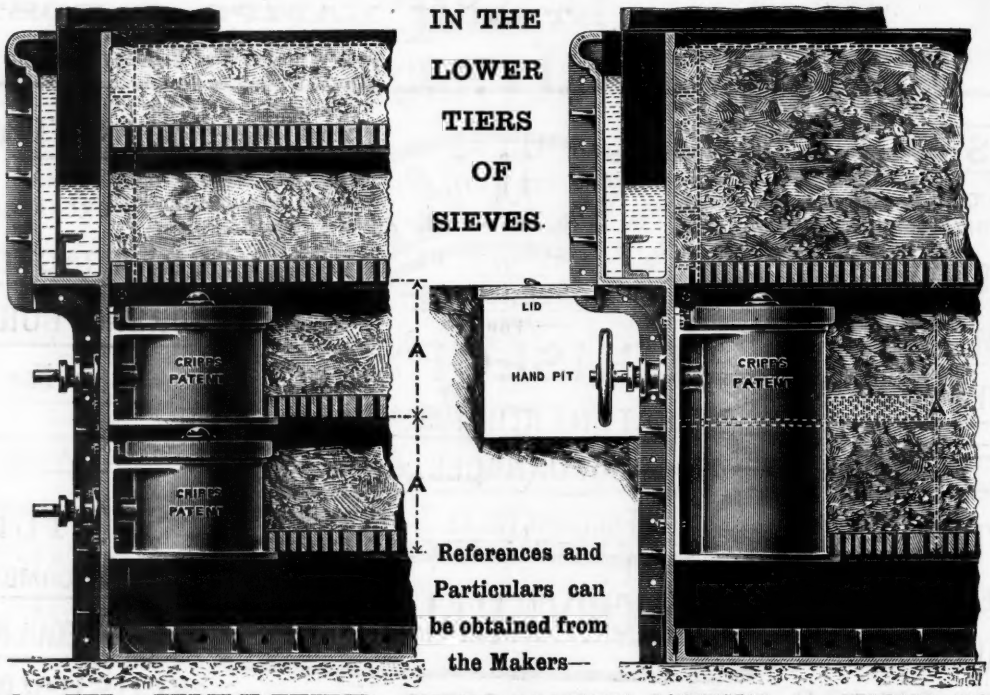

Engineers are repeating orders after thorough trial.

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Belfast	1,700,000 ,,	Preston	1,500,000 ,,
Glasgow	300,000 ,,	Southport	750,000 ,,
Brussels	700,000 ,,	Bath	1,000,000 ,,
Liverpool	3,500,000 ,,	New York	1,200,000 ,,
Tottenham	750,000 ,,	Newburgh, N.Y.	350,000 ,,
Santiago	400,000 ,,	Tottenham (Second Contract)	750,000 ,,
Swansea	750,000 ,,	St. Joseph, Mo.	750,000 ,,

And have now under Contract:—

Belfast (Second Contract)	4,500,000 Cub. Ft.	Edinburgh	2,000,000 Cub. Ft.
Shanghai	225,000 ,,	Stockton-on-Tees	500,000 ,,
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Hoylake	125,000 ,,	Norwich	1,000,000 ,,
Manchester	3,000,000 ,,	Guildford	350,000 ,,
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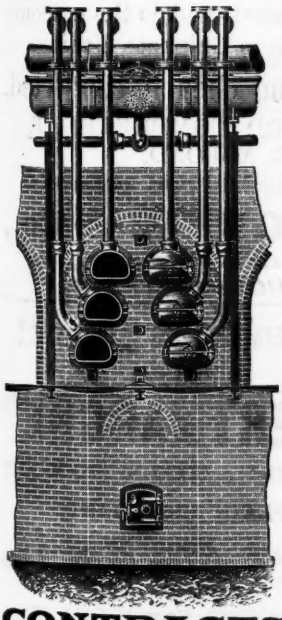

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GENERATOR FURNACES,
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SUITABLE FOR

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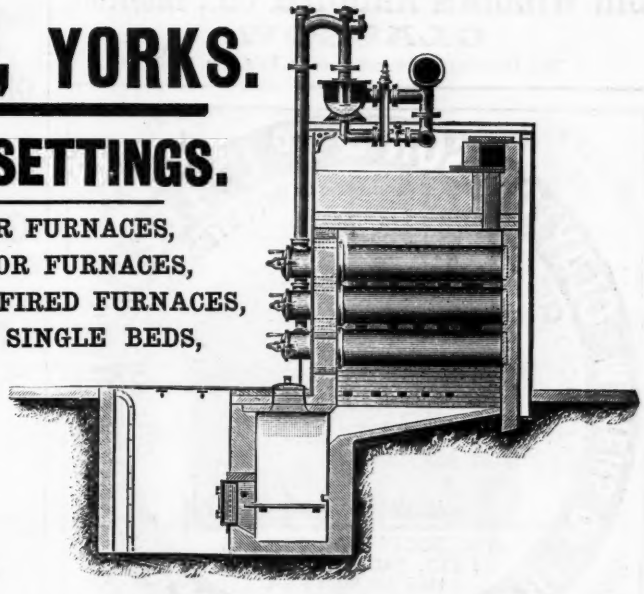

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Full Particulars may be obtained from the Sole Makers,

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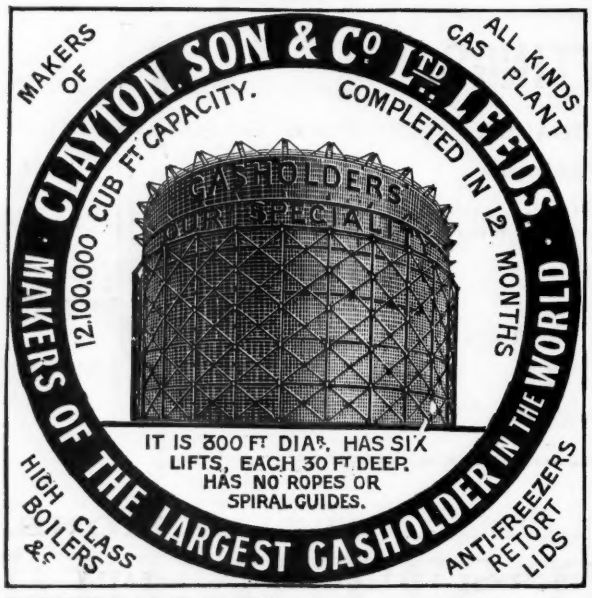
[See Illustrated Advertisement, Aug. 4, p. 236.]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[See Illustrated Advertisement, Aug. 4, p. 240.]

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SUPPLY FROM STOCK
CAST-IRON RETORTS,
AND ALL KINDS OF GAS-WORKS APPARATUS.
SOCKET-PIPES FOR GAS OR WATER PURPOSES.
FLANGE PIPES FOR STEAM.
Sole Manufacturers of LYON'S "PATENT" GAS-MAIN SYPHONS.
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Have confidence in drawing the special attention of GAS ENGINEERS to the following advantages of their Retorts:—
1. Smooth interior, preventing adhesion of Carbon.
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MACHINE-MADE GAS-RETORTS.

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ON THE CONTINUOUS SYSTEM
Is the newest in the Market, and is the outcome of practical experience in Sulphate Making.
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The most successful and approved Apparatus known up to the present time.

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RETORTS CAREFULLY PACKED FOR EXPORT.

Fire-Bricks, Lumps, Tiles, &c., &c., of every description suitable for Gas-Works.

THE PEEBLES PROCESS.

The Oil Gas Enrichment Company's Patents.

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GAS COOKER.

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May now be had with either Cast or Wrought Iron Enamelled Linings, very easily cleaned, and practically indestructible. The "Parkinson" Cooker is now fitted with the registered Cast-Iron Hinged Gate—an invaluable contrivance for ensuring a clean, well-ventilated Oven.

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"I have no sort of hesitation in testifying to the excellence and effectiveness of the Gas Cookers. Give no trouble, bake admirably, and cook to perfection."

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"They are giving our customers universal satisfaction."

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"The teachers express themselves as thoroughly pleased with them, and have put them to very considerable tests."

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"During last winter we used them at all the centres where we cooked by gas; and we shall continue to do so until we find they are superseded, which I consider unlikely."

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[See also Advt. p. 352

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